Rationale Report

Spaulding Turnpike Improvements
NHS-027-1(37), 11238

Newington to Dover
New Hampshire

January 2005

Federal Highway Administration

New Hampshire Department of Transportation

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Prepared for **New Hampshire Department of Transportation**
Concord, New Hampshire

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1 Project Description

1.1 Introduction

The New Hampshire Department of Transportation (NHDOT) is preparing an Environmental Impact Statement (EIS) to evaluate and recommend improvements to a 3.5-mile segment of the Spaulding Turnpike (US 4/NH 16) across the Little Bay Bridges extending north from the Exit 1 (Gosling Road) Interchange in Newington and through the Exit 6 (US 4/Dover Point Road) Interchange to just south of the Dover Toll Plaza in Dover, New Hampshire. The basic purpose of the Newington-Dover Spaulding Turnpike improvement project is to reduce safety problems and improve transportation efficiency, while minimizing social, economic and environmental impacts. A Scoping Report, documenting the first phase of the EIS study process, was completed in March 2004.

This Rationale Report documents Phase II of the EIS study process and includes the conceptual development, evaluation, and screening of the study alternatives identified in the *Scoping Report* for this project. An evaluation of each of the alternatives is presented as well as the rationale for eliminating specific alternatives from further consideration. The evaluation process used for this project, and for this report, comply with the Army Corps of Engineers (ACOE) guidelines under the *Highway Methodology*[1] for documenting the selection of a "reasonable range of alternatives" as defined by the National Environmental Policy Act (NEPA) and Section 404 of the Clean Water Act (CWA).

1.2 Study Area

The Spaulding Turnpike is eastern New Hampshire's major limited access North-South highway extending approximately 33.2 miles from Portsmouth to Milton, NH

[1] The *Highway Methodology* provides a useful way to integrate highway planning and design with the requirements of the Clean Water Act Section 404 permit regulations, the National Environmental Policy Act and the Federal Highway Administration (FHWA funding approvals). For more information, consult the ACOE publication *The Highway Methodology Workbook*, NEDEP-360-1-30, October 1993.

(Figure 1.2-1). The 3.5-mile Newington-Dover section of the Turnpike functions as an extension of the US 4 and NH 16 transportation corridors linking the Seacoast area and I-95 with Concord to the west and the White Mountains to the north. Locally, this section of the Turnpike also connects with Dover Point Road (Dover) to the north, and Nimble Hill Road, River Road and Woodbury Avenue (Newington) to the south.

Exit 4, Nimble Hill Rd/River Rd
(Looking North)

South of Exit 2, the Turnpike is a 6-lane divided facility, and between Exit 2 north to Exit 10, the Turnpike is a median-divided 4-lane facility. North of Exit 11, the Turnpike narrows to a 2-lane undivided facility. (Widening of the Turnpike from two lanes to a 4-lane, median-divided facility between Exits 11 and 16 is currently under design as part of a separate project.)

The section of the Spaulding Turnpike being studied (**Figure 1.2-2**) is approximately 3.5 miles long extending south from the Dover Toll Plaza to just north of Exit 1 in Newington, and includes the Little Bay Bridges. Most of this section of the Turnpike is a limited access[2] facility and consists of two (2) through lanes in each direction separated by a median of varying width. The study area includes five interchange areas (Exits 2, 3, 4, 5 and 6) including a median turnaround (Exit 4N) to accommodate southbound traffic desiring to reverse direction or access River Road in Newington.

For purposes of inventorying environmental resources which might be directly impacted as a result of improving the transportation system, the primary study area is generally defined as a band approximately 3,000 to 5,000 feet east of the northbound

[2] The existing Exxon-Mobil service station located at the Nimble Hill Road/Turnpike intersection has direct access to the Turnpike and Nimble Hill Road, along with several other parcels in Newington.

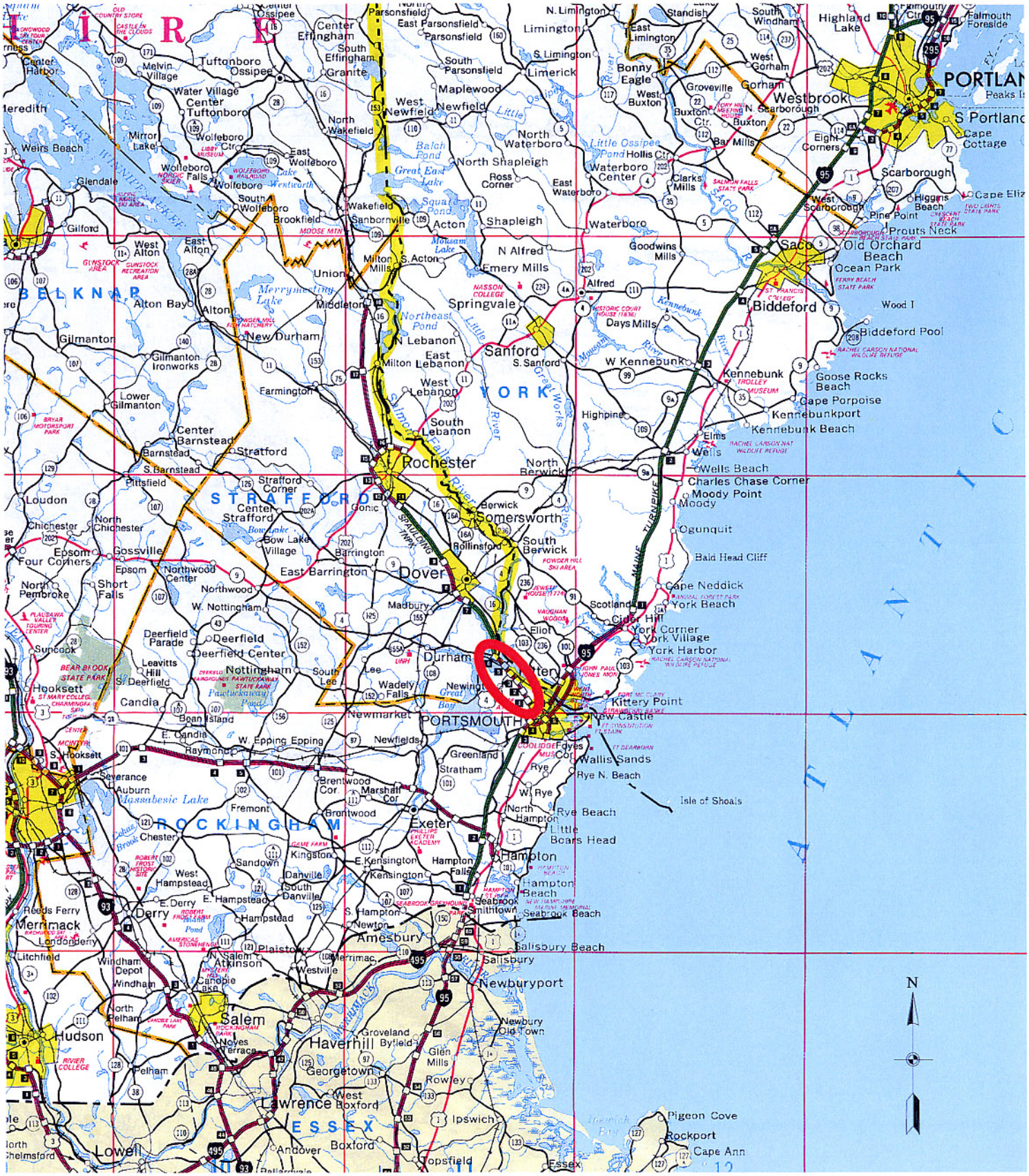

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Figure 1.2-1
Project Location Map

New Hampshire DOT
Department of Transportation

Legend:

- SURFACE WATERS
- TOWNLINE
- STATELINE
- STUDY AREA BOUNDARY

PORTSMOUTH
NEWINGTON
DURHAM
ROCKINGHAM COUNTY
STRAFFORD COUNTY
LITTLE BAY
DOVER
NEW HAMPSHIRE
MAINE
PEASE BLVD
GOSLING RD
EXIT 1
EXIT 2
EXIT 3
EXIT 4
EXIT 5
EXIT 6
ARBORETUM DR
RAILWAY BROOK
PEASE SPUR RR
PICKERING BROOK
NIMBLE HILL RD
COLEMAN DR
FLAGSTONE BROOK
TRICKY'S COVE
GENERAL SULLIVAN BRIDGE
LITTLE BAY BRIDGES
HILTON PARK
DOVER POINT
HILTON PARK
DOVER POINT RD
WENTWORTH TER
POMEROY COVE
COTE DR
DOVER POINT RD
HILTON RD
HOMESTEAD LN
PINEVIEW DR
DOVER POINT RD
BOSTON HARBOR RD
SPUR RD
SCAMMELL BRIDGE
ROYALS COVE
BELLAMY RIVER
TOLL PLAZA
FOX RUN RD
WOODBURY AVE
SHATTUCK WAY
RIVER RD
BLOODY POINT
UNNAMED PONDS
PATTERSON LN
GUILFORD RR NEWINGTON BRANCH
PISCATAQUA DR
PAUL BROOK
UNNAMED PERENNIAL STREAM
PISCATAQUA RIVER
PISCATAQUA RIVER
4
16

0 750 1500 Feet

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Figure 1.2-2
Project Study Area

lanes, including the Piscataqua River and Pomeroy Cove, a band approximately 3,000 to 5,000 feet west of the southbound lanes, including the General Sullivan Bridge and Little Bay, and the median areas. These band widths include the interchange areas and connecting roadways.

The 1998 Route 16 Corridor Protection Study[3] and the 2000 Newington-Dover Feasibility Study[4] established the project study area limits by determining that current and future Turnpike traffic operating conditions north of the Dover Toll Plaza were satisfactory. In contrast, there are poor levels of traffic service on the section of Turnpike south of the Dover Toll Plaza and north of Exit 1 in Newington under current and future volume conditions.

These boundaries mark the extent of potential direct impact to environmental resources. They do not, however, limit the evaluation of Transportation Demand Management (TDM) measures[5] and mass transit alternatives, which may logically have to extend further to the north or south. For the purpose of evaluating secondary and cumulative impacts, consideration is given to those areas serviced by, and thus subject to the influence of, the 3.5-mile section of the Turnpike in Dover and Newington under study. As such, a broad regional area (**Figure 1.2-3**) was defined to include 33 municipalities within the tri-county area of Strafford, Rockingham and Carroll Counties in the southeast portion of New Hampshire. This area is broadly referred to as the Seacoast area and was used as a basis to collect and analyze regional socio-economic data in order to provide a context within which to evaluate the proposed 3.5-mile Turnpike improvement project and its potential secondary impacts. This analysis will be conducted in the next phase (DEIS) of the study.

1.3 Safety and Traffic Conditions

The Spaulding Turnpike (NH Route 16) is a major limited access highway connecting the Seacoast Region with Concord, the Lakes Region, and the White Mountains. The Turnpike is part of the National Highway System (NHS) and is functionally classified as a principal arterial. For the segment under study, it presently consists primarily of four lanes (two lanes northbound and two lanes southbound). At the Little Bay Bridges, traffic exceeds 70,000 vehicles per day (vpd) and is expected to exceed 94,500 vpd by the year 2025.

For the ten-year period, January 1992 through December 2001, a total of 1,483 accidents were reported for the study area. Of these accidents, 575 accidents occurred

▼

[3] NHDOT, Route 16 Corridor Protection Study, December 1998.

[4] VHB, Spaulding Turnpike Improvements, Feasibility Study, Newington-Dover (11238), February 2000.

[5] Transportation Demand Management (TDM) programs aim to improve mobility and access, reduce congestion and air pollution, and provide options for commuters to get to work without increasing highway capacity. The most common TDM measures include provisions for park and ride lots, discounts or preferential treatment for vehicles serving more than one rider, improved public transit services (*e.g.*, express bus service), work hours management and other incentives which encourage the use of public transit, car-pooling, biking, walking, or simply not making the trip.

during the five-year period of January 1992 through December 1996. The remaining 908 accidents occurred over the more recent five-year period from January 1997 through December 2001, representing a 58 percent increase from the previous period. Focusing on the 1997 through 2001 time period, the frequency of accidents within the study area grew at an average rate of 11 percent per year increasing from 144 accidents in 1997 to 220 accidents in 2001. During this same time period, study area traffic volumes along the Spaulding Turnpike grew at a much lower rate of 3 percent per year. The fact that the number of accidents is increasing at a faster rate than traffic volume growth is an indicator of the deterioration of the safety along the corridor and the severity of traffic congestion.

The highest number of reported study area accidents occurred on the Little Bay Bridges where there were 97 accidents from 1997 through 2001. During the years 1997, 1998, and 1999, approximately 15 accidents per year occurred on the bridges. This number increased to 24 and 28 accidents per year in 2000 and 2001, respectively.

There were no reported fatalities during the 1997-2001 period.

During weekday peak hours, motorists traveling along the Turnpike currently experience traffic congestion and substantial delays. Operating conditions between Exits 3 and 6 are currently operating at poor levels of service (LOS) E or F. (See Section 4.2.2 for a complete description of LOS.) In addition to the capacity issues associated with the high traffic volumes, traffic flow along the Turnpike is constrained by physical infrastructure deficiencies at Exit 2, Exit 4N, Exit 4, Exit 5, and on the Little Bay Bridges.

As traffic volumes increase, traffic operations are expected to continue to deteriorate resulting in increased congestion along the mainline of the Turnpike and its interchanges, as well as along the nearby local roadways such as Dover Point Road, River Road, and Woodbury Avenue. The additional delay experienced by motorists is expected to expand to more hours of the day and to a greater number of days of the year. Accident frequency is also expected to increase as a result of the higher levels of congestion.

During the early stages of this project, the Seacoast Metropolitan Planning Organization (MPO) updated the Seacoast Regional Travel Demand Model (herein referred to as the "Model"). The Model provides the basis for projecting the future year 2025 traffic volumes for this project. In addition to forecasting future traffic volumes, the Model was used to evaluate potential roadway improvement alternatives and other transportation related strategies associated with reducing congestion along the Spaulding Turnpike.

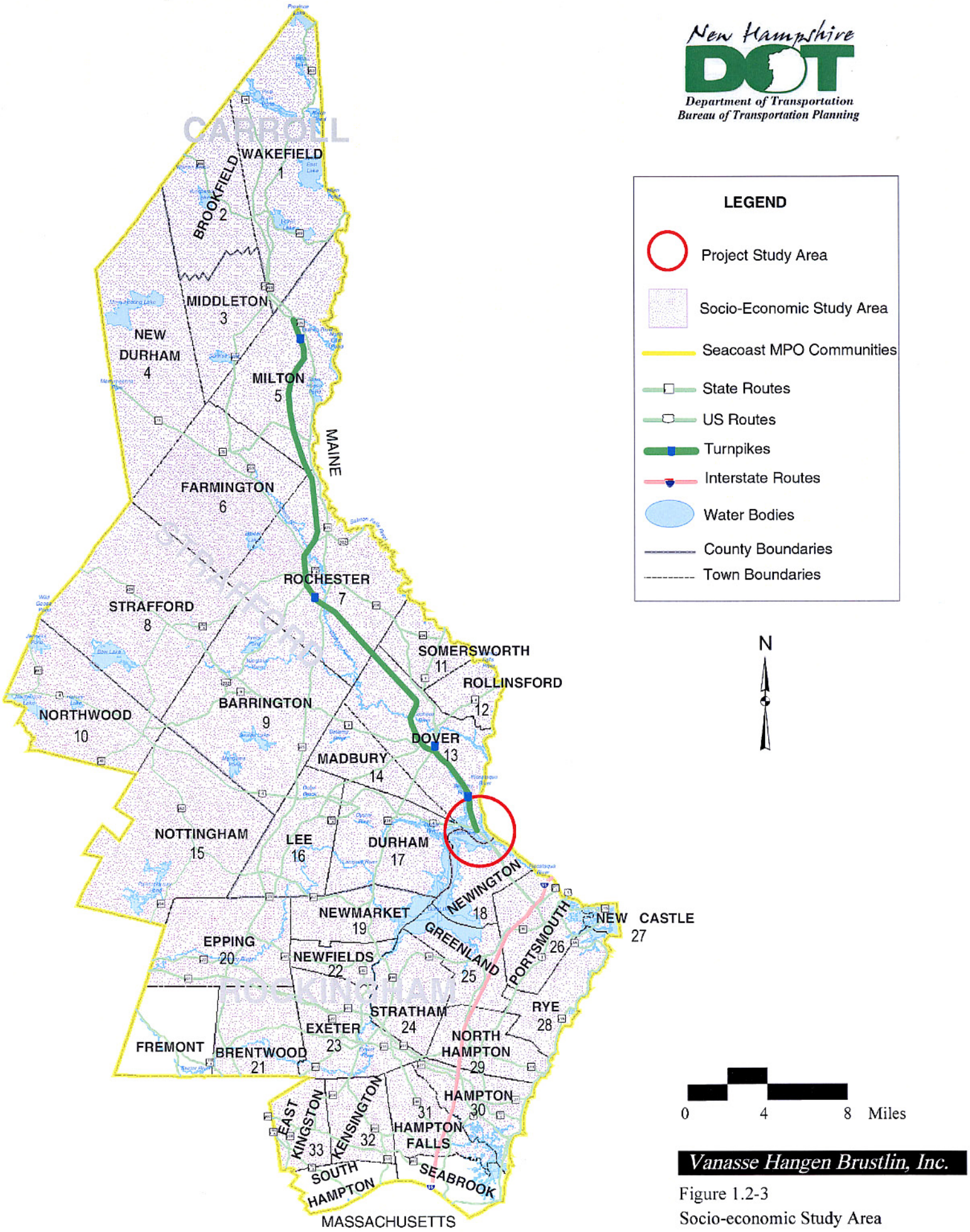

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Figure 1.2-3
Socio-economic Study Area

2

Conceptual Alternatives

2.1 Introduction

A number of conceptual alternatives were identified in the *March 2004 Scoping Report*. These alternatives provide a reasonable range of solutions to address the purpose and need of the Newington-Dover Spaulding Turnpike project. The five basic types of alternatives are listed below and discussed in more detail in the following chapters:

- No-build,
- Implementing Transportation System Management (TSM) improvements,
- Implementing Transportation Demand Management (TDM) strategies,
- Upgrading the corridor, and
- Combination of TSM, TDM and Upgrades to the corridor.

Alternative roadway and bridge crossing corridors involving relocation of the Spaulding Turnpike and a new bridge crossing location are not considered viable options because of the scale and magnitude of environmental and property impacts, the magnitude of financial investment and the current traffic patterns associated with the existing facility.

2.2 General Description of Alternatives

The following sections describe each of the basic types of alternatives. A more detailed description of the various conceptual alternatives developed within each type is presented in Chapters 3 and 4.

2.2.1 No-Build

The No-Build Alternative is essentially the continuation and perpetuation of the existing situation and the shortcomings inherent on the existing Turnpike and Little Bay Bridges. The base year 2003 Average Annual Daily Traffic (AADT) volumes range from 52,900 vehicles per day (vpd) between Exits 2 and 3 to 71,000 vpd between Exits 5 and 6. Given that the projected 2025 No-Build AADT's range from 64,700 vpd to 94,600 vpd, respectively, at the same locations, the No-Build Alternative would not

meet the project purpose and need, and in fact would result in a substantial worsening situation relative to transportation safety and mobility.

In terms of overall mobility and safety on the Turnpike, it is important to consider the magnitude of congestion with regard to the number of hours in the day that poor level of service occurs. For example, today the weekday evening peak demand on the Turnpike actually extends beyond a single hour, covering portions of two hours. This phenomenon, which is known as "peak spreading", occurs when segments of a corridor are so congested that the poor level of service extends into the hour before and following the peak hour. During the 2025 forecast year, peak spreading will become more prevalent and congestion during the weekday evening commute is expected to last up to four hours. A similar condition will also exist for the weekday morning commute. It is important to note that when peak spreading occurs, actual operating conditions of the highway are somewhat worse (and the number of motorists affected greater) than what is indicated by evaluating a single one hour period.

Figures 2.2-1 and 2.2-2 depict the 24-hour temporal distribution of respective northbound and southbound traffic volumes on Little Bay Bridges for the years 2000 and 2025. The figures contrast the unconstrained 2025 peak hour travel demand with the spreading of peak volume hours resulting from the limited two-lane capacity of the existing bridges. For example, the peak hour (5:00 PM – 6:00 PM) of congestion in 2000 will increase to approximately four hours (3:00 PM – 7:00 PM) of congestion by 2025. The current average driver delay of 8 minutes traveling northbound during the weekday PM peak hour between Exit 1 and Exit 6 on the Turnpike is expected to increase to over 20 minutes under 2025 traffic conditions. It should also be noted that the spread of peak volume hours and peak period congestion reflects a diversion of some of the 2025 peak hour travel demand to alternate routes (such as NH 108, NH 125 and ME 236) based on their capacity to absorb additional peak period traffic. As such, the No-Build Alternative is not considered a viable alternative, but will serve as a baseline condition for comparison to other alternatives.

2.2.2 Transportation System Management (TSM) Improvements

Transportation System Management (TSM) improvements are relatively low-cost measures that are implemented to reduce congestion and improve safety. TSM improvements are typically limited by the width of the existing right-of-way. Examples of TSM improvements include the construction of turning lanes, restriping lane uses, signage, the installation of new or the upgrade of existing traffic signals, and other traffic controls such as roundabouts. In addition, TSM improvements could involve the utilization of Intelligent Transportation Systems (ITS) technology, such as variable message boards and emergency communications, to ease congestion and enhance safety.

Figure 2.2-1
Temporal Distribution of 2000 and 2025 Average Weekday Traffic, Little Bay Bridges, Northbound

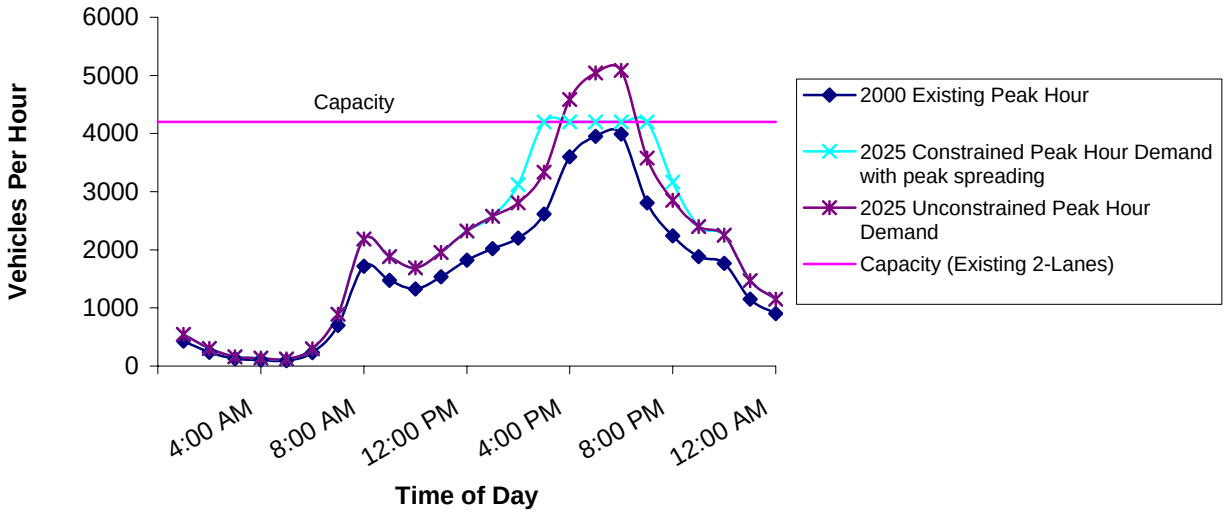
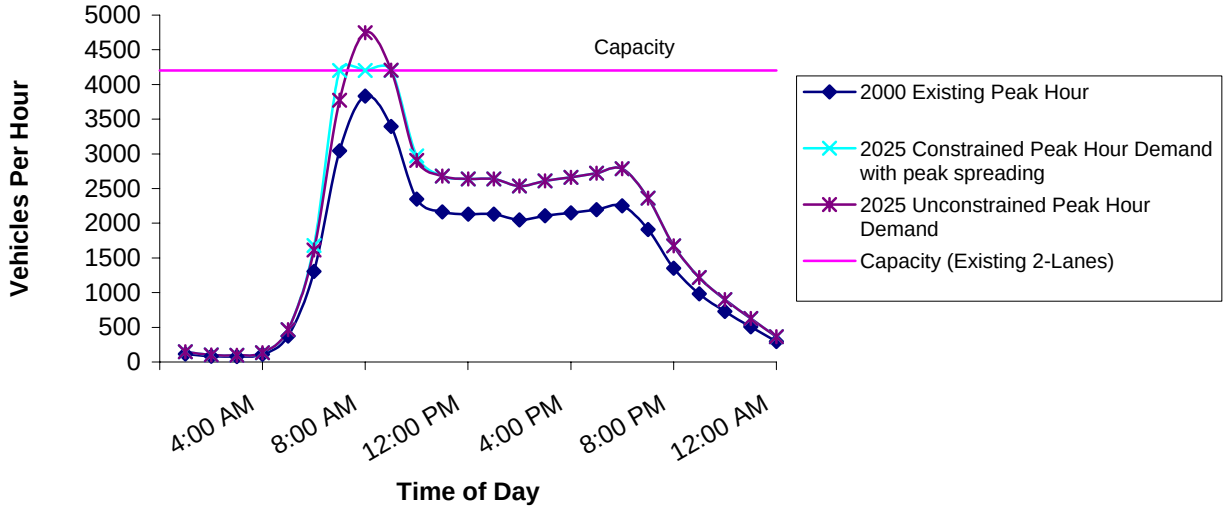


Figure 2.2-2
Temporal Distribution of 2000 and 2025 Average Weekday Traffic, Little Bay Bridges, Southbound



In the case of the Spaulding Turnpike, a number of TSM improvements are proposed to be evaluated. They include:

- Improving deceleration lanes (*e.g.*, northbound at Exit 6W in Dover and southbound at Exit 3, Woodbury Avenue in Newington),
- Minor resurfacing and restriping to better delineate traffic flow and merge areas (*e.g.*, southbound mainline approaching Exit 6 and Exit 6 southbound on-ramp in Dover),
- Developing auxiliary lanes (*e.g.*, northbound between Exits 3 and 4 in Newington), and
- Installing additional regulatory (*e.g.* Little Bay Bridges) and directional signage (*e.g.* northbound at Exit 6 in Dover).

The TSM alternatives in Newington would be developed to complement the Newington Interim Safety Improvement Project scheduled for construction in 2005. This independent project will eliminate dangerous traffic weaving areas between Exits 4 and 4N on both southbound and northbound barrels of the Turnpike.

TSM improvements are not in and of themselves the solution to the long-term needs of the Spaulding Turnpike study area. However, they would provide immediate localized improvement of safety conditions and traffic congestion relief in advance of the long-term solutions to be approved and constructed.

2.2.3 Transportation Demand Management (TDM) Strategies

Transportation Demand Management (TDM) encompasses a variety of strategies that are designed to change personal travel behavior to reduce the demand for automobile use and the need for roadway and bridge capacity expansion. This is accomplished through measures that reduce the number or length of drive-alone trips or that move trips out of times of peak roadway congestion.

TDM measures focus on providing incentives (or disincentives) to drivers who drive alone to encourage them to change their travel behavior to ride-share or use other modes of travel. The discussion of TDM measures in this section of the report does not include consideration of major infrastructure investments to provide and expand alternative modes of transportation such as high occupancy vehicles (HOV) lanes, park and ride facilities, bus services, and rail service. Options for providing these types of improvements to serve the Spaulding Turnpike corridor are described and analyzed in detail in Chapter 3.

Employer-Based Measures

Employer-based programs are designed to encourage and support the use of alternatives to driving alone. TDM programs are generally targeted at work trips because commuters account for most peak-hour travel (the periods of regular roadway congestion) and because work trip patterns are generally consistent from day-to-day. TDM strategies are most effective in changing commuting behavior if they are implemented through employers. As a result, employers are frequently responsible for funding TDM programs, at least in part. This reliance on private funding differentiates TDM programs from more traditional transportation services and creates opportunities for public/private partnerships to address transportation issues.

Nationally, a large variety of TDM strategies have been adopted. The most commonly implemented strategies include:

- Programs that encourage the use of transit, such as on-site sale of transit passes, employer shuttles to transit stations, employer subsidies for transit use, and adequate parking at transit stations.
- Ride-matching programs and preferential parking at the work site for carpools and vanpools.
- Bicycle and pedestrian amenities such as bicycle storage, showers and lockers, and improved pathways and access.
- Support programs for those who commute via alternative modes, such as on-site services (shopping, banking, food services, day care, *etc.*) and guaranteed ride-home programs.
- Variable work arrangements and work hours such as telecommuting, flextime, and compressed work weeks.

Implementation of TDM programs may occur voluntarily or may be required through government regulations. The government can also encourage TDM programs through financial incentive programs.

Transportation Management Associations

Implementation of voluntary TDM programs is frequently facilitated through ride-share brokerages or transportation management associations (TMAs). Both are public/private partnerships that design, market, and implement programs that support commuting alternatives and may administer incentives to employees who use the alternatives. These organizations also collaborate with state and local governments, public agencies, and transit operators to increase the availability of transportation alternatives.

Although these organizations exist in a variety of sizes and operational structures, they generally use government support in combination with private funding, which is obtained through cash grants, member dues, fees for services, or in-kind

contributions. Ride-share brokerages offer area-wide services, but also work with individual employers to implement TDM programs at individual work sites. TMAs support groups of employers that band together to address specific transportation issues in their area by implementing TDM measures for member employers.

Typically both types of organizations work with employers to provide a variety of TDM programs including ride-matching, on-site transit pass sales, employer shuttles to transit, guaranteed ride-home programs, parking management, flexible work hours, and telecommuting. In addition, these organizations offer technical assistance to employers, provide marketing materials, and sponsor promotional events to educate employees about their commuting options.

Most work-related travel along the Spaulding Turnpike corridor is to workplaces at the Pease Tradeport, in downtown Portsmouth, and in Massachusetts. Massachusetts destinations include downtown Boston and Cambridge, communities along the I-95 (MA 128) and I-495 circumferential highways around Boston, and employers along I-95 and US 1 between Boston and the New Hampshire state line. Based on 2000 Census journey-to-work data, employer-based TDM measures that could have the most impact on the Spaulding Turnpike in the study area would need to be implemented largely at the Pease Tradeport and in downtown Portsmouth.

The Pease Development Authority helped create the Greater Portsmouth Transportation Management Association (TMA) in 2002. The goal of the Greater Portsmouth TMA is to encourage employees to use other modes of transportation such as transit, carpool or vanpool. The TMA provides a ride-matching program as well as a guaranteed ride-home program. In addition, the TMA provides information on existing transit services provided by the Cooperative Alliance for Seacoast Transportation (COAST), Wildcat Transit, C&J Trailways, Vermont Transit and Amtrak. The TMA also helps employers set up Commuter Choice Initiatives. These initiatives provide tax savings to employers and employees who use alternative modes and do not drive alone to work.

Other Transportation Demand Management Services

The Seacoast Metropolitan Planning Organization (MPO) has created an Alternative Transportation Guide which is available on the internet. The website[6] contains information regarding ride-matching services, transit, park-and-ride lots and bicycle commuting. The website also includes links to additional websites which contain specific information about each service.

The NHDOT operates a Statewide Rideshare Program through its Bureau of Rail and Transit. The program is approximately 10 years old and has not yet built a substantial database. There are currently about 700 commuters registered for ride-matching.

[6] www.seacoastmpo.org

The State's Rideshare Coordinator also promotes ridership through individual employers by sponsoring transportation events, providing marketing materials, and encouraging employers to adopt TDM strategies, such as guaranteed ride-home programs, parking management, flextime, and telecommuting.

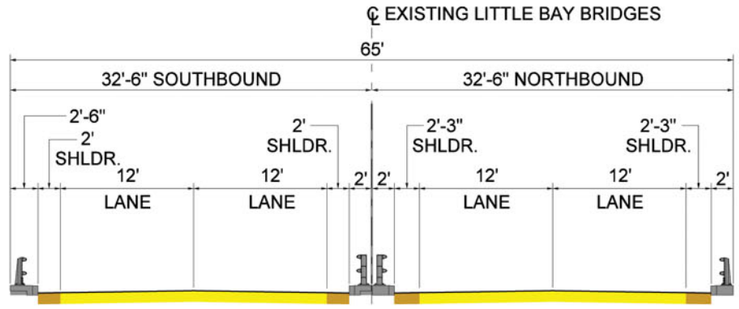
2.2.4 Adding Lanes to the Spaulding Turnpike and Little Bay Bridges

Concepts for addressing existing and future travel demands for the Spaulding Turnpike study area include adding travel lanes to the existing Turnpike and Little Bay Bridges. Alternatives to be considered involve widening the existing roadway and bridges to provide either three or four lanes in each direction (**Figure 2.2-3**). Relative to the widening alternatives, incorporation of high occupancy vehicle (HOV) lanes and/or reversible lanes to serve immediate or future needs are also considerations.

Current interchange configurations and connecting roads within the study area will be evaluated for possible consolidation and design improvements to accommodate the widening and projected traffic demand, as appropriate, based on current American Association of State Highway Transportation Officials (AASHTO) and NHDOT design standards.

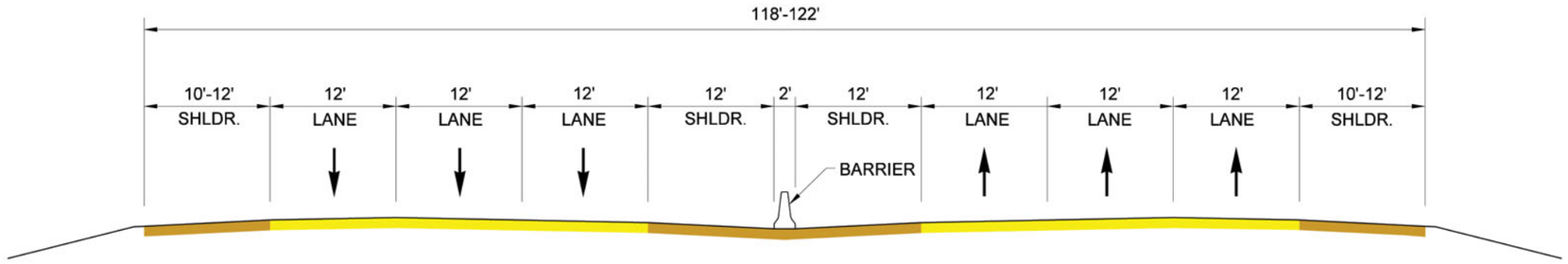
2.2.5 Combination of Alternatives

During the alternatives development process it may become apparent that a combination of alternatives will provide the most benefit to the project and best meet the project's purpose and need. Each of the alternatives will be evaluated with the potential of combining it with other alternatives, where practical, to provide the most effective range of reasonable alternatives.

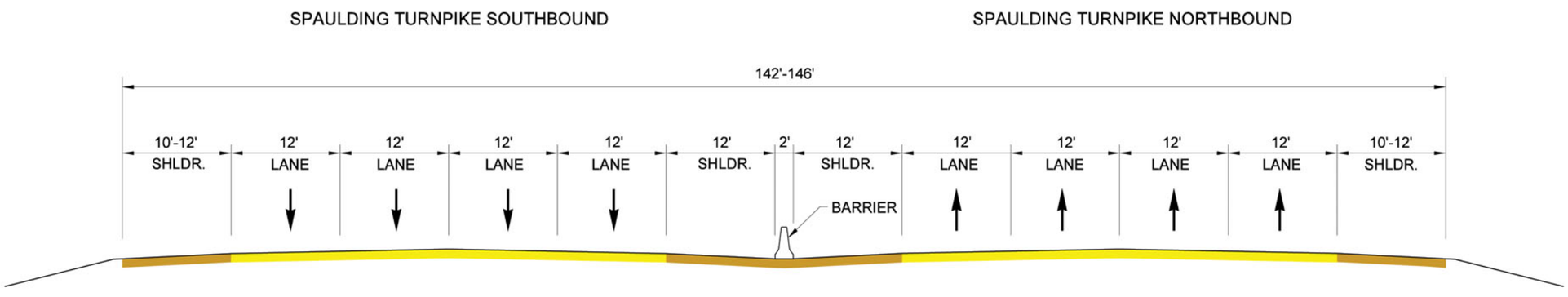


*EXISTING FOUR - LANE CROSS SECTION

* CROSS SECTION SHOWN ON LITTLE BAY BRIDGES



SIX - LANE TYPICAL SECTION



EIGHT - LANE TYPICAL SECTION

Figure 2.2-3
Typical Roadway / Bridge
Cross Sections

3

Development of Mode Alternatives

3.1 Introduction

As part of the analysis of the potential improvements to the Spaulding Turnpike and Little Bay Bridges between Exit 1 and the Dover Toll Plaza, an evaluation of alternative transportation modes was conducted. These alternative modes include rail services, bus services, HOV lanes and reversible lanes. Employer-based programs to encourage employee alternatives to driving alone to work were also assessed. The objective for analyzing these other modes was to understand how they may complement and minimize the need for and extent of highway and bridge improvements. Based on 2025 travel demand projections and current travel characteristics (*e.g.*, time, purpose and frequency of travel, mode of travel, vehicle occupancy, *etc.*) four (4) travel lanes are required for both northbound and southbound directions of the Turnpike and Little Bay Bridges to provide satisfactory level of service (LOS) D traffic flow characteristics during weekday morning and evening peak hours.

This Chapter describes the individual HOV, rail, and bus modes considered. It also reviews the methodology used to project rail, bus and HOV ridership, and presents the results of the analysis of potential ridership for the various modes, along with a sensitivity analysis of ridership estimates vis-à-vis travel time and cost.

The mode options that were selected include four rail options, three HOV lane options, and three bus options. Following establishment of parameters describing the capabilities and limitations of each option, all the options were preliminarily tested individually and in combinations under different roadway and bridge infrastructure scenarios: the existing 4-lane condition; a 6-lane (3 lanes northbound and 3 lanes southbound) facility; and an 8-lane (4 lanes northbound and 4 lanes southbound) facility.

The mode options analyzed were chosen based on technology, financing, and infrastructure that are available today or are feasible. The intent was to test the ridership potential of alternative modes under favorable but realistic conditions. The parameters used to define the options did not necessarily limit the capacity of the various options. For example, sufficient parking was assumed at each bus or rail

station, or park-and-ride facility, to accommodate all potential demand. Similarly, a sufficient number of seats per train or buses were assumed to be available to satisfy projected demand.

Based on the preliminary analysis results, those mode options deemed feasible and practicable were combined with each other and assessed under the different (4-lane, 6-lane and 8-lane) infrastructure scenarios. The range of ridership estimates reflects a sensitivity to travel time and cost. (See Tables 3.7-1 through 3.7-4).

3.2 High Occupancy Vehicle Lanes

HOV facilities provide lanes dedicated to vehicles carrying more than one person. The number of people required per vehicle and the time periods the lanes are so dedicated are dependent on the demand for the lanes. To be successful, the HOV lanes must not be congested or there will be little incentive for drivers of single occupancy vehicles (SOV) to consider ride-sharing or bus services. In addition, the HOV lane must not be under-utilized, or motorists in general use lanes will question the merit of having HOV lanes.

Four (4) HOV lane options were conceptually developed and are depicted in the cross sections in **Figures 3.2-1 and 3.2-2**.

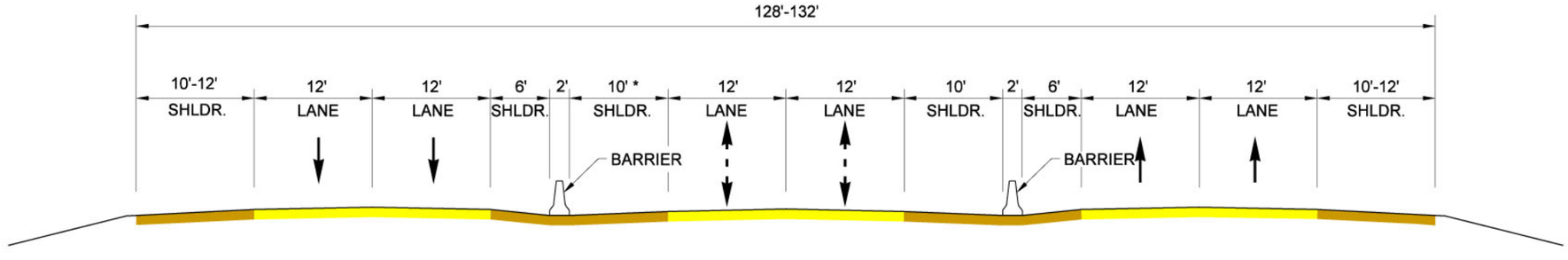
- The first option consists of a 6-lane cross section providing two (2) southbound and two (2) northbound general purpose lanes, and two (2) reversible center lanes which would flow southbound during the weekday morning peak period and flow northbound during the weekday evening peak period (**Figure 3.2-1**). However, 2025 travel demand estimates of 4,000 vehicles per hour require three (3) travel lanes in the off-peak direction during summer weekends for a satisfactory (LOS D) level of service. Existing capacity is approximately 4,200 vehicles per hour. As such, this option is not viable, and was not pursued.

- The second option consists of a 7-lane cross section providing three (3) southbound and three (3) northbound general purpose lanes, and a single (1) reversible center lane which would flow southbound during the weekday morning peak period and flow northbound during the weekday evening peak period (**Figure 3.2-1**).

- The third option consists of a 6-lane cross section with moveable barriers that will allow four lanes of travel in the weekday peak direction of flow (and two lanes of travel in the off peak direction) by borrowing a lane from the off-peak direction for either HOVs or traffic in general (**Figure 3.2-2**). This concept is commonly referred to as a "zipper lane". During the weekends, three lanes would be provided in each direction. It should be noted that a single moveable barrier – as opposed to the median barriers conceptualized in **Figure 3.2-2** – was deemed

SPAULDING TURNPIKE SOUTHBOUND

SPAULDING TURNPIKE NORTHBOUND

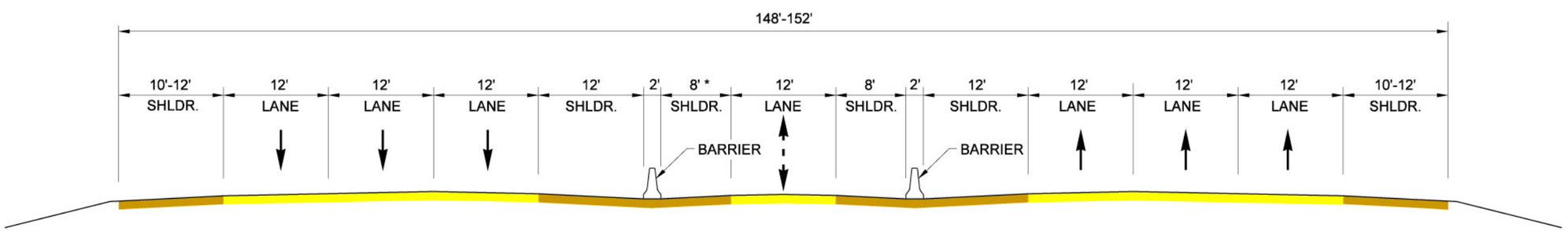


(* reduced typical 4')

SIX - LANE WITH TWO CONTRAFLOW HOV LANES TYPICAL SECTION

SPAULDING TURNPIKE SOUTHBOUND

SPAULDING TURNPIKE NORTHBOUND



SEVEN - LANE WITH ONE CONTRAFLOW HOV LANE TYPICAL SECTION

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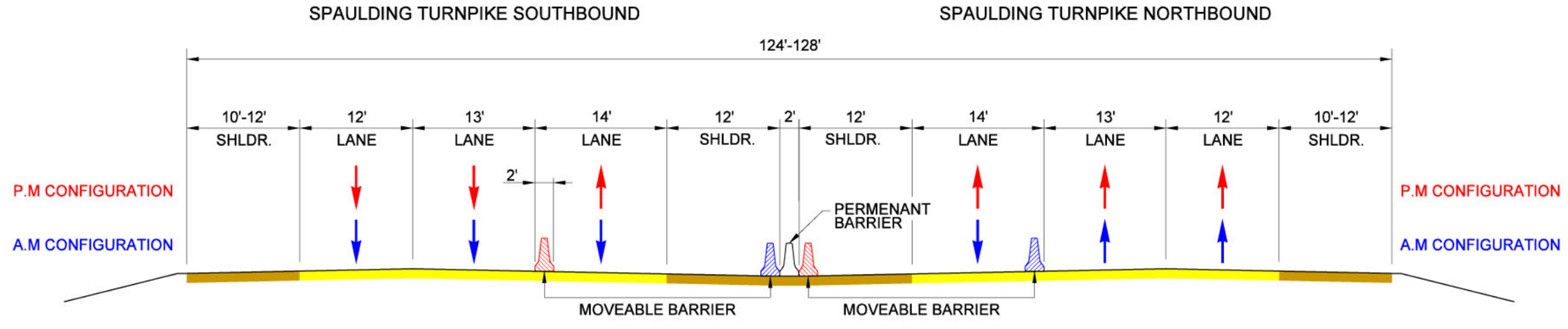
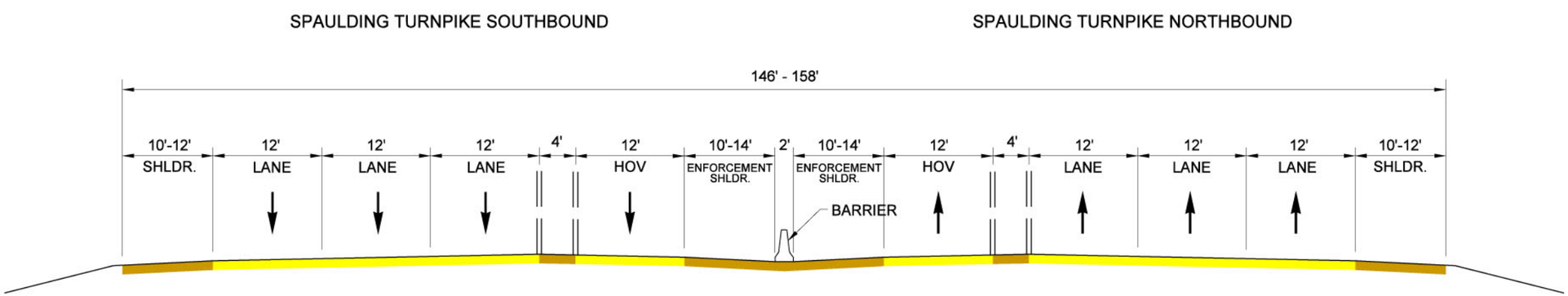
Figure 3.2-1
Six and Seven Lane
Contraflow HOV
Typical Section Alternatives



SIX - LANE WITH CONTRAFLOW (ZIPPER LANE) LANE TYPICAL SECTION



EIGHT - LANE WITH CONCURRENT HOV LANE TYPICAL SECTION

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Figure 3.2-2
Six Lane Contraflow (Zipper Lane) and Eight Lane Concurrent Flow HOV Typical Section Alternatives

infeasible. Piers located in the median at Exit 3 and at Exit 6 will be required to structurally support the grade-separated roadways which traverse the Turnpike at these locations. Such piers preclude the possibility of shifting a single barrier from the southbound side of the Turnpike to the northbound side.

- The fourth option consists of an 8-lane cross section that provides concurrent flow HOV lanes in each direction (**Figure 3.2-2**).

Under Options 2, 3 and 4, three (3) operating scenarios are considered for the north and south termini of the HOV lanes:

- Dover Toll Plaza to I-95
- Dover Toll Plaza to Exit 1
- Exit 6 (US 4) to Exit 1

3.3 Rail Alternatives

Based on the information presented in the *Scoping Report*, four rail alternatives were identified for preliminary analysis. These conceptual rail alternatives were developed to address two complementary goals: diverting automobile trips to passenger rail service, and diverting freight traffic from truck to rail. Both goals work to address congestion on the Spaulding Turnpike. Several of these alternatives included sub-options for different alignments, and one sub-option considered Bus Rapid Transit on a fixed guideway as an alternate technology. The alternatives that were developed are listed below:

- Rail Alternative 1: Expanded *Downeaster* Service
  - Rail Alternative 1A: Dover to Boston
  - Rail Alternative 1B: Rochester to Boston via Dover

- Rail Alternative 2: Rochester to Portsmouth via Dover
  - Rail Alternative 2A: Rochester to Portsmouth via Dover and Rockingham Junction (Commuter Rail)
  - Rail/Fixed Guideway Alternative 2B: Rochester to Portsmouth via Dover and the Spaulding Turnpike Corridor (Commuter Rail or Bus Rapid Transit)

- Rail Alternative 3: Conway Branch
  - Improvements to the Conway Branch, which runs from Rollinsford Junction to North Conway, to support passenger rail service or improved freight rail service

- Rail Alternative 4: Pease Spur
  - Restoration of the Pease Spur from the Newington Branch into the Pease Tradeport to not preclude resumption of freight rail service into Pease

Figure 3.3-1 shows the proposed alignments of these four conceptual rail alternatives.

The Scoping Report had also identified the Main Line East as a potential candidate for passenger rail service and improvements to freight rail service. Consideration of passenger rail service along the Main Line East was eliminated because the most viable option, an extension of the Massachusetts Bay Transportation Authority (MBTA) Newburyport Line commuter rail service to Portsmouth, does not address the purpose and need of this study. While the potential for the service was documented in the 1999 study prepared by the Rockingham Planning Commission (RPC)[7], the action would not help to improve transportation along the 3.5-mile segment of the Spaulding Turnpike under study. Consideration of freight rail improvements on the Main Line East was eliminated because service on the rail line does not, and would not, directly impact truck traffic volumes in the study area. The majority of truck trips that could potentially be diverted to rail to traverse this line would come from Interstate 95 and do not, or would not, use the Spaulding Turnpike. A further discussion of the potential for diversion of freight traffic from truck to rail is contained later in this chapter.

In the development of Rail Alternative 2, several different modal options were considered for each alignment (Rochester-Portsmouth via Rockingham Junction and Rochester-Portsmouth via the Turnpike Corridor). An initial analysis of Commuter Rail, Light Rail Transit (LRT), and Bus Rapid Transit (BRT) was performed for both alignment options to identify the infrastructure requirements and order-of-magnitude capital cost estimates in each case. In the case of LRT and BRT, it was assumed that a dedicated, fixed guideway would be constructed for the length of the corridor. As a result of this initial analysis, LRT and BRT were eliminated from consideration in Rail Alternative 2A because of the major infrastructure requirements associated with separating the LRT or BRT guideway from the freight rail operations on the corridor. Similarly, LRT was eliminated from consideration in Rail Alternative 2B because of the major infrastructure requirements associated with separating the LRT vehicles from the freight and intercity trains on the Main Line West and crossing the Main Line West track to access the Conway Branch. BRT was carried forward for further analysis in Alternative 2B because the required guideway and crossing of the Main Line West could be constructed at a cost closer to that of commuter rail.

The following sections present brief descriptions of the conceptual rail alternatives that were developed for further analysis, the key infrastructure and equipment requirements associated with the alternatives, and their conceptual capital costs. The capital cost estimates include both infrastructure and equipment costs, and have been developed following the Federal Transit Administration (FTA) guidelines for the preparation of cost estimates. The infrastructure estimates include a 30 percent contingency for unknowns and a 20 percent allowance for survey, design, and

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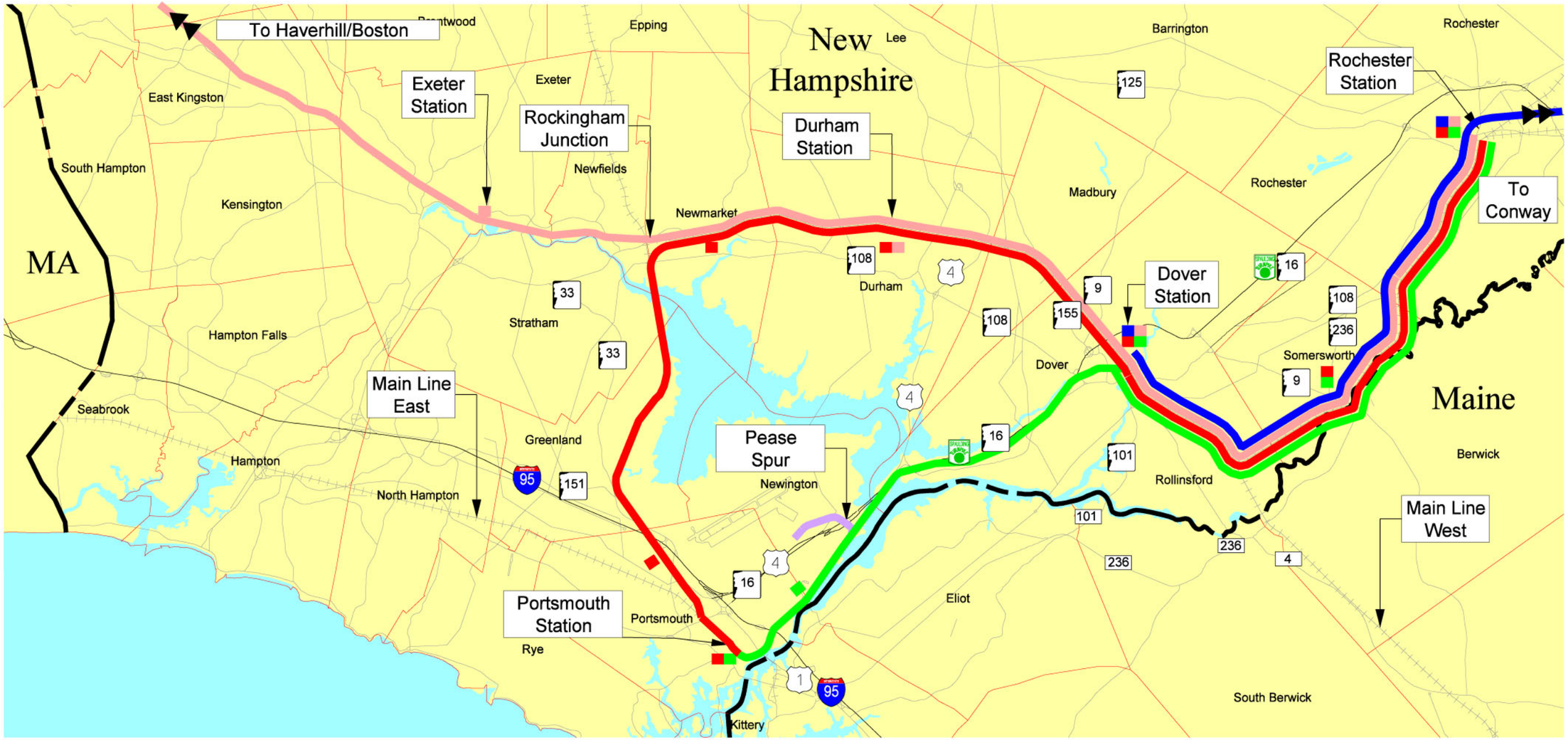
7 *Commuter Rail Service to Coastal New Hampshire: A Feasibility Study for the Hampton Branch*, Rockingham Planning Commission, June 30, 1999.

New Hampshire DOT
Department of Transportation



Legend:

- ALT. 1 Alignment/Station
  Expanded Downeaster Service
- ALT. 2A Alignment/Station
  Rochester-Portsmouth
  via Rockingham Junction
- ALT. 2B Alignment/Station
  Rochester-Portsmouth
  via Turnpike
- ALT. 3 Alignment/Station
  Conway Branch
- ALT. 4 Alignment
  Pease Spur

N

0 1.25 2.5 Miles

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Figure 3.3-1
Rail Alternatives

construction services. As the alternatives are developed further, the cost estimates would be revised and these allowances would be reduced to reflect the development of more detailed plan information. The conceptual capital costs do not include the cost of land acquisition, although acquisition may be required in some cases. The equipment cost estimates reflect typical industry unit costs for orders of all sizes. It has been assumed that NHDOT would combine any equipment orders for this project with other orders to produce larger order sizes; otherwise, a small-order cost premium might be incurred.

3.3.1 Rail Alternative 1 – Expanded *Downeaster* Service

This alternative would enhance the current *Downeaster* intercity rail service to/from Boston by adding one round trip (one AM peak southbound trip, one PM peak northbound trip) to the current *Downeaster* schedule. The new round trip would originate and terminate in New Hampshire. There are two possible passenger service options in this alternative:

- Rail Alternative 1A would operate passenger service between Dover and Boston, stopping at the existing *Downeaster* stations along the route.

- Rail Alternative 1B would extend the above service onto the Conway Branch to Rochester.

The proposed operating plan, schedule, and fares would be the same between Dover and Boston in both options; in Alternative 1B, the schedule and fare structure would simply be extended to Rochester. Freight rail service could also be indirectly improved through the additional infrastructure investment associated with this alternative.

The infrastructure needs associated with this alternative include minor station modifications in Dover and Durham (Alternatives 1A and 1B); a new station in Rochester (Alternative 1B); and a layover facility in Dover for overnight storage of equipment (Alternatives 1A and 1B). There has also been discussion that a second track may be needed between Dover and the Massachusetts state line (a distance of approximately 30 miles) to facilitate the expansion of the *Downeaster* service. Although it does not appear that the addition of the proposed one daily round trip would necessitate the construction of the second track, the cost of the second track has been provided as a point of reference.

The equipment needs are for one additional trainset[8] to operate the service. At present, the Northern New England Passenger Rail Authority (NNEPRA) leases the

[8] A trainset is a set of train equipment capable of carrying passengers or freight and providing its own propulsion. Passenger trainsets traditionally consist of a locomotive and one or more passenger coaches. However, diesel multiple unit (DMU) or Electric Multiple Unit (EMU) technology, in which each rail car provides both propulsion and passenger capacity, may also be used.

equipment used for the *Downeaster* service from Amtrak. The pool of available intercity equipment from Amtrak is limited; therefore, it has been assumed that a new set of equipment would need to be purchased. There are two technology options for the purchase of the equipment: 1) a traditional trainset consisting of a locomotive and coaches or 2) self-propelled diesel rail cars (Diesel Multiple Units, or DMUs). A trainset consisting of DMU cars would be less expensive than a traditional locomotive hauled trainset. Table 3.3-1 summarizes the estimated capital cost of Rail Alternative 1A assuming the use of DMU equipment.

Table 3.3-1
Capital Costs of Rail Alternative 1A (with DMU equipment)

Item	Capital Cost
Rail Alternative 1A (without second track)	
Infrastructure Subtotal	*$1.6 million*
Contingency and Survey/Design/Construction Services	*$0.8 million*
Infrastructure Total	$2.4 million
Equipment Total	$7.5 million
Grand Total – Rail Alternative 1A (without second track)	**$9.9 million**
Rail Alternative 1A (with second track Dover to NH-MA state line)	
Infrastructure Subtotal	*$65.1 million*
Contingency and Survey/Design/Construction Services	*$32.5 million*
Infrastructure Total	$97.6 million
Equipment Total	$7.5 million
Grand Total – Rail Alternative 1A (with second track)	**$105.1 million**

As shown in the table above, the conceptual capital cost of Rail Alternative 1A, with DMU equipment, ranges from $9.9 million without double-tracking to $105.1 million with construction of a second track from Dover to the New Hampshire-Massachusetts state line. The incremental cost of extending service to Rochester (Rail Alternative 1B) is an additional $400,000 for the construction of a station stop in Rochester. The use of traditional rail equipment (locomotive and coaches) rather than DMU equipment would cost an additional $3.7 million.

3.3.2 Rail Alternative 2 – Rochester to Portsmouth via Dover

This alternative would provide local rail service for commuters between the Rochester, Dover, and Portsmouth areas. Service would be provided on weekdays at 45-minute headways during peak periods and two-hour headways during off-peak periods. There are two possible alignment options for this alternative:

- Rail Alternative 2A would operate along three existing, active rail corridors: the Conway Branch from Rochester to Rollinsford; the Main Line West through Dover to Rockingham Junction; and the Portsmouth Branch to downtown Portsmouth, a distance of approximately 35 miles. The service would stop at existing stations in Dover and Durham, and would also serve new station stops in Rochester, Somersworth, Newmarket, and two locations in Portsmouth (near the Portsmouth Transportation Center and in downtown Portsmouth).

- Rail Alternative 2B would operate along four existing rail corridors (three active, one abandoned) and along one new rail alignment for a distance of approximately 24 miles. It would utilize the Conway Branch from Rochester to Rollinsford; the Main Line West to Dover Station; the abandoned Sawyer/Dover Branch to the Spaulding Turnpike right-of-way; a new alignment along the east side of the Turnpike Corridor across Pomeroy Cove and Little Bay on new structures; and the Newington Branch into downtown Portsmouth. The service would stop at the existing station in Dover, and would also serve new station stops in Rochester, Somersworth, at the east end of Gosling Road in Newington, and downtown Portsmouth.

Rail Alternative 2A assumes the operation of a commuter rail service using fully Federal Railroad Administration (FRA) compliant equipment to take advantage of the existing rail infrastructure that is in place along the alignment. In this option, three trainsets would be required to operate the service, with a fourth set as a spare. For Rail Alternative 2B, two modal options were evaluated: a commuter rail service using fully FRA compliant equipment to take advantage of the existing rail infrastructure between Dover and Rochester and between Little Bay and Portsmouth, and a Bus Rapid Transit (BRT) service on a dedicated guideway constructed along the Conway Branch, Main Line West, Sawyer/Dover Branch, Turnpike Corridor, and Newington Branch. In Rail Alternative 2B, three commuter rail trainsets or three articulated BRT vehicles would be needed to provide the service, with a fourth set of equipment as a spare in each case. Freight rail service could also be indirectly improved through the infrastructure investments associated with the commuter rail options in this alternative.

The infrastructure needs for Rail Alternative 2A include construction of a second track along the Main Line West from Dover to Rockingham Junction; reconstruction of the Portsmouth Branch; construction of passing sidings on the Conway and Portsmouth Branches; installation of a signal system on the Conway and Portsmouth Branches; modifications to the signal system along the Main Line West; a layover and servicing

facility in Dover; modifications to the existing Dover and Durham stations; and construction of five new stations. The modifications to the Dover and Durham stations are assumed to include construction of a new platform and canopy adjacent to the new second track, and the addition of 50 parking spaces. New station stops are assumed to include a new platform, canopy, and approximately 50 parking spaces. These new station stops would be located in Rochester, Somersworth, Newmarket, and at two locations in Portsmouth. The Portsmouth locations would include a station stop near the Portsmouth Transportation Center (at a location which could be served by the COAST Tradeport Trolley), and a stop in downtown Portsmouth.

The infrastructure needs for Rail Alternative 2B (Commuter Rail) include construction of a new rail alignment from the Dover Station to the Little Bay along the Turnpike Corridor; reconstruction of the Newington Branch; construction of passing sidings on the Conway Branch and along the new rail alignment; installation of a signal system on the Conway and Newington Branches and along the new rail alignment; rail crossings of Pomeroy Cove and Little Bay on new structures; a layover and servicing facility in Dover; modifications to the Dover Station; and construction of four new stations. The modifications to the Dover station are assumed to include construction of a new platform and canopy adjacent to the new second track, and the addition of 50 parking spaces. New station stops are assumed to include a new platform, canopy, and approximately 50 parking spaces. These new stations would be located in Rochester, Somersworth, at the east end of Gosling Road in Newington (which would serve the Pease Tradeport and nearby retail areas via a shuttle connection), and downtown Portsmouth. Rail Alternative 2B (Commuter Rail) would likely impact Hilton Park (a Section 4(f) resource) on the north side of the channel, and would impact several other properties along the Turnpike right-of-way between Little Bay and downtown Dover.

The infrastructure needs for Rail Alternative 2B (Bus Rapid Transit) include construction of a new dedicated, fixed guideway from Rochester to Portsmouth along the Conway Branch, Main Line West, the Turnpike Corridor, and the Newington Branch; special guideway bridges across the Main Line West, Pomeroy Cove, Little Bay, and North Mill Pond (in downtown Portsmouth); a storage and servicing facility in Dover; modifications to the Dover Station; and construction of four new stations. The modifications to the Dover station are assumed to include construction of a new bus shelter and turnout, and the addition of 50 parking spaces. New station stops are assumed to include a bus shelter and turnout and approximately 50 parking spaces. These new stations would be located in Rochester, Somersworth, at the east end of Gosling Road in Newington (which would serve the Pease Tradeport and nearby retail areas via a shuttle connection), and downtown Portsmouth. Alternative 2B (Bus Rapid Transit) would likely impact Hilton Park (a Section 4(f) resource) and would impact several other properties along the Turnpike right-of-way between Little Bay and Dover and along the Main Line West between Dover and Rollinsford Junction.

Table 3.3-2 summarizes the estimated capital cost of Rail Alternative 2 (infrastructure and equipment):

Table 3.3-2
Capital Costs of Rail Alternative 2

Item	Capital Cost
Rail Alternative 2A (Commuter Rail)	
Infrastructure Subtotal	*$64.4 million*
Contingency and Survey/Design/Construction Services	*$32.2 million*
Infrastructure Total	$96.6 million
Equipment Total	$37.4 million
Grand Total – Rail Alternative 2A (Commuter Rail)	**$134.0 million**
Rail Alternative 2B (Commuter Rail)	
Infrastructure Subtotal	*$79.8 million*
Contingency and Survey/Design/Construction Services	*$39.9 million*
Infrastructure Total	$119.7 million
Equipment Total	$37.4 million
Grand Total – Rail Alternative 2B (Commuter Rail)	**$157.1 million**
Rail/Fixed Guideway Alternative 2B (Bus Rapid Transit)	
Infrastructure Subtotal	*$116.2 million*
Contingency and Survey/Design/Construction Services	*$58.1 million*
Infrastructure Total	$174.3 million
Equipment Total	$2.1 million
Grand Total - Rail/Fixed Guideway Alt. 2B (Bus Rapid Transit)	**$176.4 million**

3.3.3 Rail Alternative 3 – Conway Branch

This alternative considers improvements to the Conway Branch, which runs from Rollinsford Junction to North Conway, as a way of attracting a passenger service operator or improving freight rail service on the Conway Branch. Total distance from North Conway to Dover via the Conway Branch and the Main Line West is approximately 72 miles. The Conway Branch is currently in service from Rollinsford Junction to near Route 28 in Ossipee, and in Conway and North Conway. A 22-mile segment of the Conway Branch between Ossipee and the Albany-Conway Town Line is currently inactive. Restoration of this segment would permit the resumption of

freight rail service from Rollinsford to North Conway, improving the connectivity of the freight rail network from northern New Hampshire to the study area and points south and west. Restoration of the Conway Branch would also permit the operation of a passenger rail service which could connect to the *Downeaster* service at Dover.

The NHDOT completed a study in June 2004 that examined the feasibility of re-establishing the 22-mile abandoned segment of the Conway Branch between Ossipee and Conway. The study considered a three-phase approach to the track restoration. Phase 1 would include work needed immediately to restore service on the line. This Phase would restore the track to FRA Class I standards, which would be sufficient for freight services in the short-term but would limit passenger service operating speeds to 15 miles per hour. Phase 2 would include work required to sustain service that would need to be completed within five years. Phase 3 would include the cost of upgrading the rail to permit heavier freight traffic as well as passenger operation. Phase 1 is estimated to cost about $6.2 million, Phase 2 is projected to cost $1.3 million, and the Phase 3 upgrade is estimated to cost $11 million.

For the purpose of the Spaulding Turnpike Improvements Study, it was assumed that the track would need to be upgraded to FRA Class IV standards and maintained to FRA Class III standards (permitting 60 MPH passenger operating speeds) to establish an attractive passenger rail service on the Conway Branch. A service plan consisting of two daily round trips, scheduled to meet the *Downeaster* service in Dover, was considered. A morning trip out of North Conway would meet the second southbound *Downeaster* trip departing from Dover to Boston, then would meet the first northbound trip arriving in Dover. The afternoon Conway Branch trip would meet the last southbound *Downeaster* trip from Dover to Boston, then would meet the last northbound trip arriving in Dover. It was assumed that the Conway Branch service would be a seasonal tourist-based service operating daily in the summer and Friday through Sunday during other times of the year.

The infrastructure needs for Rail Alternative 3 include upgrading the track along the 22-mile section between Ossipee and Conway from FRA Class II to Class IV standards; modifications to the Dover Station; and construction of five new stations along the Conway Branch. The modifications to the Dover station are assumed to include construction of a new platform and canopy for a potential second track or siding, and the addition of 50 parking spaces. New station stops are assumed to include a platform, canopy and approximately 50 parking spaces. It is assumed that these new station stops would be located in Rochester, Sanbornville, Ossipee, West Ossipee, and Conway[9]. The equipment needs for Rail Alternative 3 are one set of self-propelled rail cars. Table 3.3-3 summarizes the estimated capital cost of Rail Alternative 3 (infrastructure and equipment). The costs of individual phases of

[9] There is an existing station stop served by the Conway Scenic Railroad in Conway; however, for the purposes of the capital cost estimate it has been assumed that the infrastructure required at this location would be similar to that required at a new station.

rehabilitation from the NHDOT Feasibility Study are shown separately from the costs of improvements specific to Rail Alternative 3.

Table 3.3-3
Capital Costs of Rail Alternative 3

Item	Capital Cost
Initial Work Identified in NHDOT Conway Branch Feasibility Study	
Rehabilitate to FRA Class I (NHDOT Study Phases 1 and 2)	$7.5 million
Upgrade from FRA Class I to Class II (NHDOT Study Phase 3)	$11.0 million
Total - NHDOT Conway Branch Feasibility Study	**$18.5 million**
Rail Alternative 3 Improvements (Upgrade from FRA Class II to Class IV)	
Infrastructure Subtotal	*$8.1 million*
Contingency and Survey/Design/Construction Services	*$4.1 million*
Infrastructure Total	$12.2 million
Equipment Total	$7.5 million
Total - Rail Alternative 3 Improvements	**$19.7 million**
Grand Total – Conway Branch	**$38.2 million**

3.3.4 Rail Alternative 4 – Pease Spur

In Rail Alternative 4, the Pease Spur would be restored from the Newington Branch into the Pease Tradeport to not preclude the resumption of freight rail service into Pease. The *Pease Surface Transportation Master Plan*[10] included the goal of attracting businesses that could be served by rail to the Tradeport; restoration of the Pease Spur is an important step towards making this happen. Restoration of the spur would involve off-site improvements including the potential relocation of a segment of the spur to accommodate the grade separation of the Spaulding Turnpike crossing of the spur, as well as reconstruction of the remaining segment of the spur and a segment of track into the Tradeport. The resumption of freight rail service would be dependent on attracting new (or existing) businesses to receive and/or ship materials by rail. The potential freight rail operator would develop an operating plan and schedule based on the requirements of customers on site.

[10] Pease Surface Transportation Master Plan, 1994; Updated 2002.

Table 3.3-4 summarizes the estimated capital cost of Rail Alternative 4. The table includes two main cost components: the rail cost, which includes capital cost of reconstructing the rail infrastructure (sub-ballast, ballast, ties, rail, turnouts, and grade crossings) from the Newington Branch to the existing spur line on the Tradeport, and the roadway cost — the cost of excavation, embankment, drainage, and bridge work necessary to achieve the grade separation of the Spaulding Turnpike from the rail spur. The cost of any rail reconstruction within the Tradeport (outside the limits of the rail relocation) is not included in this estimate. Both cost components are shown as a range of figures, reflecting the variations in track alignment, number of grade crossings, roadway configuration, and earthwork associated with the various roadway alternatives. Refer to Tables 5.3.1 and 5.3.2 for further information about the roadway cost elements associated with the Pease Spur.

Table 3.3-4
Capital Costs of Rail Alternative 4

Item	Capital Cost
Rail Alternative 4 – Rail Cost	
Infrastructure Subtotal	*$0.8 - $1.3 million*
Contingency and Survey/Design/Construction Services	*$0.4 - $0.6 million*
Infrastructure Total	$1.2 – $1.9 million
Rail Alternative 4 – Roadway Cost (Note: Roadway Costs are also included in Tables 5.3.1 and 5.3.2)	$0.5 - $5.8 million
Grand Total - Rail Alternative 4	**$1.7 - $7.7 million**

3.4 Bus Alternatives

Three bus alternatives were developed for preliminary analysis. The primary goal of these alternatives was to attract peak-period riders who might otherwise drive along the Spaulding Turnpike corridor in the study area. The alternatives were developed to build upon and complement existing bus services in the area, including C&J Trailways intercity service and local services operated by the Cooperative Alliance for Seacoast Transportation (COAST) and the University of New Hampshire (UNH) Wildcat Transit. One of the proposed alternatives would also build upon an express bus service planned by COAST, which is expected to begin operations in 2006. The alternatives that were developed are listed below:

- Bus Alternative 1: Expanded Intercity Service
- Bus Alternative 2: Expanded Turnpike Express Service
- Bus Alternative 3: Expanded Local Service

Figure 3.4-1 depicts the proposed routes of these three conceptual bus alternatives.

One other bus alternative was developed initially, and then eliminated from further analysis based on feedback from the local transit operators in the area. The aim of this alternative was to create new local routes that would serve the Pease Tradeport directly from Rochester, Dover and Durham, eliminating the need for transfers to the COAST Tradeport Trolley. A conceptual service plan for the alternative was developed that proposed two new routes, one between Rochester, Dover and the Tradeport, and another between Durham and the Tradeport. Based on feedback received from COAST and Wildcat Transit, this alternative was eliminated in favor of Bus Alternative 3, which improves headways and creates an improved transfer point between existing COAST and Wildcat Transit routes.

The following sections present brief descriptions of the conceptual bus alternatives that were developed for further analysis, the key infrastructure and equipment requirements associated with the alternatives, and their conceptual capital costs. The capital cost estimates include both infrastructure and equipment costs, and have been developed following the Federal Transit Administration (FTA) guidelines for the preparation of cost estimates. The infrastructure estimates include a 30 percent contingency for unknowns and a 20 percent allowance for survey, design, and construction services. As the alternatives are developed further, the cost estimates would be revised and these allowances would be reduced to reflect the development of more detailed plan information. The conceptual capital costs do not include the cost of land acquisition, although acquisition may be required in some cases. The equipment cost estimates reflect typical industry unit costs for orders of all sizes. It has been assumed that NHDOT would combine any equipment orders for this project with other orders to produce larger order sizes; otherwise, a small-order cost premium might be incurred.

It should be noted that all the bus alternatives include some common elements, such as park-and-ride facilities; therefore the total cost of a combined package of bus improvements is less than the total cost of the three separate alternatives.

3.4.1 Bus Alternative 1 – Expanded Intercity Service

This alternative would provide expanded intercity coach bus service to serve the commuter market between the Rochester-Dover-Portsmouth area and Boston. The route would begin at new park-and-ride facilities located near the Spaulding Turnpike in Rochester (Exit 12) and Dover (Exit 9), and then follow the Turnpike and I-95 to the existing Portsmouth Transportation Center (PTC). From there, buses would travel express to Boston via I-95, making one or two stops in Boston near Haymarket Square and the Financial District before terminating at South Station. Service would be provided at 45-minute headways during peak periods and two-hour headways during off-peak periods. This schedule of service would likely require five buses, plus an additional two spares. Fares would be established at rates comparable

to those on the existing intercity bus service between Dover, Portsmouth and Boston, as well as the *Downeaster* intercity rail service.

The infrastructure needs associated with Bus Alternative 1 include construction of two new park-and-ride facilities. Equipment needs include seven buses (five to meet the proposed schedule and two spares). Table 3.4-1 summarizes the estimated capital cost of Bus Alternative 1 (infrastructure and equipment):

Table 3.4-1
Capital Costs of Bus Alternative 1

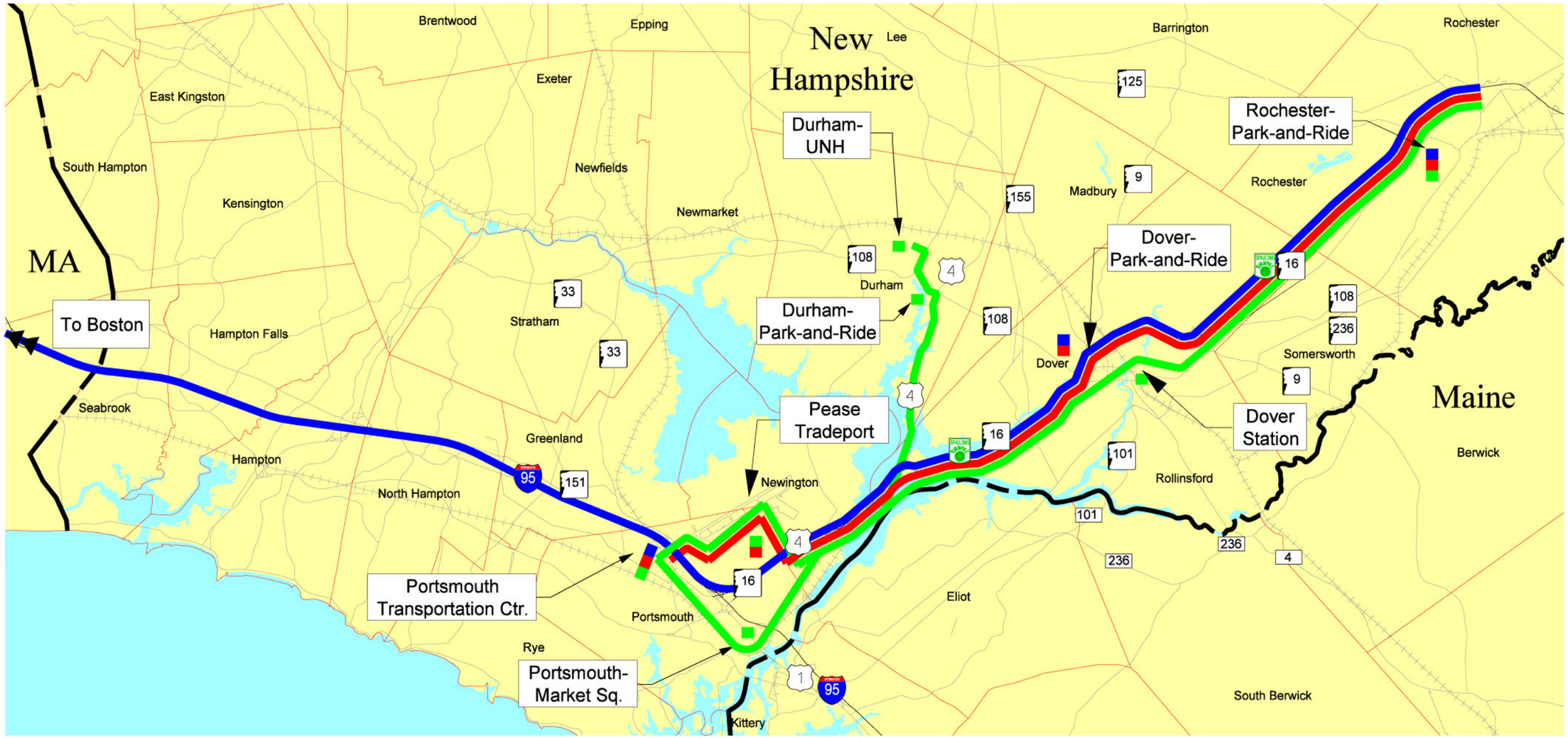
Item	Capital Cost
Infrastructure Subtotal	*$2.6 million*
Contingency and Survey/Design/Construction Services	*$1.3 million*
Infrastructure Total	$3.9 million
Equipment Total	$3.0 million
Grand Total – Bus Alternative 1	**$6.9 million**

3.4.2 Bus Alternative 2 – Expanded Turnpike Express Service

This alternative would provide expanded express commuter bus service to allow residents in Rochester and Dover to reach jobs at the Pease Tradeport in Portsmouth more quickly than on local COAST routes. It would build on the Spaulding Turnpike Express service that is currently planned by COAST, which would provide service on 30 to 45-minute headways from Rochester to Pease/PTC in the morning and from Pease/PTC to Rochester in the evening. In this alternative, the planned service would be expanded through the construction of park-and-ride facilities in Rochester (Exit 12) and Dover (Exit 9), and by an improvement to either a 20-minute peak-hour headway or a consistent 25-minute peak-period headway. This proposed expanded service could be operated with the three buses that are to be acquired by COAST with CMAQ funding for the Spaulding Turnpike Express service, plus one additional bus to provide the improved headways. This alternative could possibly be enhanced with the use of a potential HOV lane or dedicated busway on the Turnpike to reduce travel times.

The infrastructure needs associated with Bus Alternative 2 include construction of two new park-and-ride lots. The equipment costs include the purchase of one transit bus. Table 3.4-2 summarizes the estimated capital cost of Bus Alternative 2 (infrastructure and equipment):

New Hampshire DOT
Department of Transportation



Legend:

- ALT. 1 Route/Stop Expanded Intercity Service (Rochester-Boston)
- ALT. 2 Route/Stop Expanded Express Service (Rochester-Portsmouth Transportation Center)
- ALT. 3 Route/Stop Expanded Local Service

N

0 1.25 2.5 Miles

Vanasse Hangen Brustlin, Inc.

Figure 3.4-1
Bus Alternatives

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Table 3.4-2
Capital Costs of Bus Alternative 2

Item	Capital Cost
Infrastructure Subtotal	*$2.6 million*
Contingency and Survey/Design/Construction Services	*$1.3 million*
Infrastructure Total	$3.9 million
Equipment Total	$0.3 million
Grand Total – Bus Alternative 2	**$4.2 million**

3.4.3 Bus Alternative 3 – Expanded Local Service

This alternative would build on the strengths of three existing transit routes (the COAST Route 2, Wildcat Transit Route 4, and the COAST Tradeport Trolley) by improving headways during peak periods; improving the ability to collect passengers by adding new park-and-rides; and improving the distribution of passengers to the Pease Tradeport through the creation of a transfer point at Exit 1/Gosling Road/ Pease Boulevard. The COAST Route 2 provides local service from Rochester to Market Square, Portsmouth. The Wildcat Transit Route 4 provides local service from the UNH campus and Durham to downtown Portsmouth. The COAST Trolley provides local service in two connected loops, one serving downtown Portsmouth, and the Portsmouth Transportation Center, and the other serving downtown Portsmouth and the Lafayette Road area of Portsmouth. This alternative would improve local service along the Turnpike Corridor and strengthen the transit connection from Rochester, Dover and Durham to the Tradeport.

The infrastructure associated with Bus Alternative 3 would include construction of two new park-and-ride lots (one in Rochester at Exit 12 and one near the US 4/NH 108 Interchange in Durham) and the construction of a transfer point at Exit 1/Gosling Road/Pease Boulevard that would include bus turnouts, shelters, walkways, and lighting. The equipment needs include the purchase of two new transit buses and a replica trolley bus. Table 3.4-3 summarizes the estimated capital cost of Bus Alternative 3 (infrastructure and equipment):

Table 3.4-3
Capital Costs of Bus Alternative 3

Item	Capital Cost
Infrastructure Subtotal	*$3.6 million*
Contingency and Survey/Design/Construction Services	*$1.8 million*
Infrastructure Total	$5.4 million
Equipment Total	$1.0 million
Grand Total – Bus Alternative 3	**$6.4 million**

3.5 Park-and-Ride Facilities

One element common to many of the conceptual roadway, and transit alternatives is the construction of new park-and-ride capacity along the Spaulding Turnpike corridor in and around the study area. These park-and-ride lots would serve two primary markets: drivers wishing to create carpools or vanpools before traveling on the Turnpike through the study area, or drivers wishing to utilize one of the proposed transit alternatives. In both cases, drivers would leave their automobiles at a park-and-ride facility and continue along the Turnpike in a shared-ride or transit mode, reducing the number of vehicles and congestion levels on the Turnpike in the study area.

Several park-and-ride facilities have been proposed as part of the conceptual bus alternatives described in Section 3.4. These include facilities along the Turnpike in Dover at Exit 9, in Rochester at Exit 12, and a facility near the US 4/NH 108 interchange in Durham. Each facility would include approximately 300 parking spaces, one or more bus bays, and amenities including a small passenger building, restrooms, lighting, benches, and an overhang over the bus bays. The conceptual cost of each park-and-ride facility has been estimated at approximately $2.0 million, not including land acquisition costs. These park-and-ride facility costs are included in the overall capital costs estimates for each bus alternative in Section 3.4.

The conceptual rail alternatives described in Section 3.3 would also include provision for park-and-ride spaces at stations other than downtown Portsmouth. However, these locations are not anticipated to be used for carpool or vanpool commuting since most are not directly on the Spaulding Turnpike. The costs of these park-and-ride spaces are included in the capital costs for the rail alternatives in Section 3.3.

3.6 Methodology for Projecting Ridership for Rail, Bus and HOV Modes

The following sections describe the methodologies used to project HOV utilization, reductions in roadway volumes associated with TDM programs, and ridership for various bus and rail service alternatives. These projections were used to calculate reductions in peak hour traffic volumes on the Spaulding Turnpike. Level of service for the reduced traffic volumes was analyzed to determine the potential impact of the alternative modes on the need for highway and bridge improvements. The potential impact of traffic diversions on traffic operations associated with the provision of alternative modes forms the basis for recommendations of further study of alternative modes to serve travel demands along the Newington-Dover section of the Spaulding Turnpike.

3.6.1 Rail and Bus Ridership Methodology

The methodology used to project bus and rail transit ridership is described in the *National Cooperative Highway Research Program (NCHRP) Report 187: Quick-Response Urban Travel Estimation Techniques and Transferable Parameters*. This or similar methods have been used for planning transit projects by public agencies nationwide. The process for projecting 2025 ridership for each rail and bus option is presented below.

The 2025 commuter population was projected using the following two steps:

1. The market or service area for each bus or rail station was identified. Each Strafford County town was assigned to the Rochester, Dover or Durham station based on proximity and location "upstream" from the station on the route of the trip. If one of those three stations was not part of a bus or rail alternative, the towns assigned to it were reassigned to the next most appropriate station. For transit alternatives that provided no service from Durham, towns in the Durham service area were assigned to Dover. Similarly, for alternatives with no service to Rochester, Rochester service area towns were assigned to Dover.

2. The 2025 daily population commuting from each market/service area to jobs in Boston, Newington, and Portsmouth was projected from the 2000 journey-to-work (JTW) data based on projected trip growth from the regional travel demand model. The resulting number of trips represented 2025 trips from each service area to Boston, Newington, and Portsmouth. These data were disaggregated to smaller areas in Newington (east and west of the Turnpike) and Portsmouth (Pease Tradeport, downtown, northeast Portsmouth, etc.) based on the future distribution of employment used in the regional travel demand model. Daily trips were converted to peak hour trips based on the ratio of peak hour to daily trips from the 2000 journey-to-work data.

To determine how much of the 2025 commuter population would take transit, the auto and rail impedances for each origin and destination pair were compared. Transit and automobile travel impedances were measured in minutes and included total travel time associated with each trip. The impedances also included out-of-pocket costs converted to time (minutes) based on a rate of $17.50 per hour for trips to the Portsmouth area and $35.00 per hour for trips to downtown Boston. These values are based on average wage rates for the Portsmouth area (May 2003) and downtown Boston (first quarter 2004).

The following describe what times and costs were included in the calculations of both auto and transit impedances.

1. The auto impedance includes:
    a) Driving travel time from home to work place
    b) Incremental or marginal cost of driving (at $0.16 per mile) – marginal cost is used for the analysis because the use of transit for commuting to work is not expected to reduce the number of vehicles owned by the transit commuter. Therefore, the costs of basic auto ownership, such as insurance and depreciation, are assumed to remain constant and there will only be savings in operating costs for fuel, oil and maintenance. The marginal cost was developed from American Automobile Association data adjusted for the increase in the price of gasoline to $2.00 per gallon.
    c) Average cost per day for parking ($14.00 in downtown Boston; $2.00 in downtown Portsmouth) – the average cost per day for parking in Boston includes daily costs based on monthly parking rates obtained from the Boston Transportation Department and assuming shared costs for carpoolers. No adjustment was made for commuters who receive free or subsidized parking. The rate for Portsmouth is based on recently approved municipal parking rates.

2. The transit impedance includes:
    a) Drive time to station (10 minutes)
    b) Waiting time at station (5 minutes)
    c) Rail or bus travel time based on service plan
    d) Average shuttle travel time of 10 minutes plus 2.5 minute transfer time to shuttle service
    e) Average travel time from rail or bus terminal to final work destination (15 minutes for Boston, 10 minutes for downtown Portsmouth, and 5 minutes for the Pease Tradeport and all other destinations)
    f) Incremental or marginal cost of driving to station (at $0.16 per mile)
    g) Bus or rail fare based on monthly passes if available.

The transit share was then calculated for each area by using the logit mode choice equation described in the NCHRP Report 187, "Quick-Response Urban Travel Estimation Techniques and Transferable Parameters". The equation defines an S-

shaped curve which represents the attractiveness of transit based on estimated transit and automobile impedances for travel between two locations. The transit share calculated by the model is applied to the projected peak hour commuter trips to calculate the peak hour transit ridership.

3.6.2 HOV Utilization Methodology

The physical configuration of the proposed HOV facility (e.g., concurrent flow lane, contraflow lane or separate reversible flow lane) did not factor into the projections of usage. The analysis methodology assumed that, whatever the configuration, there would be sufficient enforcement of restrictions on lane use that would keep the HOV lane free-flowing until HOV volume reached the capacity of the HOV lane. All non-HOVs were restricted to using the available general purpose lanes and the travel time in the general purpose lanes was estimated based on projected levels of service.

The following presents the steps used to project 2025 utilization of the HOV lane for the HOV options described previously. The analysis was conducted for southbound travel in the morning peak hour and northbound travel in the evening peak hour. These are the peak flows on the Spaulding Turnpike which provide access from residences in Strafford County to employment in the Pease Tradeport, City of Portsmouth and northeastern Massachusetts, including Boston.

- Using the regional travel demand model, the number of through trips between the following pairs of locations on the Spaulding Turnpike was calculated:
  - Dover Toll Plaza to I-95
  - Dover Toll Plaza to Exit 1 (Pease Boulevard/Gosling Road)
  - Exit 6 (US 4) to Exit 1 (Pease Boulevard/Gosling Road)

- Through trips were calculated from the 2025 model for both the morning and evening peak hours using a select link analysis for the links comprising the Spaulding Turnpike between the paired locations listed above.

- The number of HOVs in the through traffic stream between the pairs of locations listed above was calculated by multiplying the through volume by 11 percent. Based on the New Hampshire Seacoast Travel Survey conducted in June 2003, approximately 19 percent of respondents who reported they traveled by car traveled in a vehicle with another person. This is equivalent to about 11 percent of vehicles having more than one person.

- Assuming the HOV facility will accommodate 2+ HOVs (two or more persons in each vehicle), all through HOVs were assigned to the HOV facility and all remaining SOVs were assigned to the general purpose lanes.

- The number of HOVs in the HOV lane in the peak hour was increased based on projected time savings for travel in the HOV lane compared to travel in the general purpose lanes. According to literature research, a travel time savings between 5 and 10 minutes results in a 20 to 30 percent increase in the number of HOVs, a travel time savings of 10 to 15 minutes results in a 30 to 40 percent increase in HOVs, and a travel time savings of greater than 15 minutes results in a 40 to 50 percent increase in HOVs.[11] Assuming uncongested operations in the HOV facility, the travel time savings in the HOV lane was prorated based on length of the lane. The HOV lane between the toll plaza and I-95 was assumed to save the full amount of the delay for traveling the entire length of the study corridor.

- Based on the projected travel time saving, the base HOV volume was increased by the appropriate percent indicated above.

- The number of single occupancy vehicles in the general purpose lane was reduced to reflect the diversion to HOV trips. Two SOVs were eliminated from the general purpose lanes for each HOV created and added to the HOV lane.

- The resulting volume in the general purpose lanes was used to determine the projected level of service in the general purpose lanes with the provision of an HOV facility.

3.6.3 Travel Demand Management

The United States Environmental Protection Agency (EPA) COMMUTER Model was used to project reductions in work trips to areas served by moderate and aggressive TDM programs. This model calculates the transportation and emissions benefits of Commuter Choice and other voluntary strategies to reduce single occupancy vehicle (SOV) commuting. COMMUTER offers two levels of analysis: Regional analyses can be done on programs covering an urban area, a central business district or a highly-traveled corridor. Site-specific analyses enable benefits to be projected for programs at individual worksites. The model, which is used mainly to support air quality analyses, projects the percent reduction in trips based on the share of employees in the area covered by various TDM measures in the following categories:

- Site Walk Access Improvements – preferential parking, improved walk access to transit
- Transit Service Improvements – more frequent and/or faster service to the site
- Financial Incentives – parking cost subsidies, transit fare/pass subsidies, or other financial incentives

[11] Wesemann, Larry. "Forecasting Use on Proposed High-Occupancy-Vehicle Facilities in Orange County, California, *Transportation Research Record.* Pp. 1-12.

- Employer Support Programs – support programs for carpooling, vanpooling, transit, and/or bicycling
- Alternative Work Schedules – flex time, telecommuting, staggered work hours, and/or compressed work weeks

Measures in the transit service improvements category were not included in this analysis to avoid double counting the ridership projections for bus and rail transit alternatives. The financial incentives category assumes the availability of transit service to the area being analyzed.

The percent reductions obtained from the program were applied to 2025 peak hour trips between Strafford County municipalities and the Pease Tradeport, downtown Portsmouth and downtown Boston based on projected journey-to-work data. The total reductions for each section of the Spaulding Turnpike were subtracted from the projected 2025 No-build traffic volume to obtain a projected traffic volume with each TDM program.

The following is a list of TDM measures analyzed by the COMMUTER program to develop trip reductions for moderate and aggressive TDM programs. Numbers in parenthesis indicate the assumed employer participation rates, respectively, for the moderate and aggressive TDM programs.

- Preferential parking for carpools and vanpools (10%; 20%)
- Reduced parking fees for carpools/vanpools (15%; 30%)
- Subsidies for vanpools (15%; 30%)
- Transit subsidies (15%; 30%)
- Employer support programs such as on-site transportation coordinator, ride-matching services, and transit schedule and route information (30%; 60%)
- Alternative work schedules such as flex-time, compressed work weeks, staggered work hours, and telecommuting (10-20%; 20-40%)

3.7 Alternative Modes Ridership and Utilization Projections

The following sections present the results of the application of the methodologies described above to the HOV, bus and rail alternatives described in Sections 3.2 through 3.4. Traffic reductions associated with moderate and aggressive TDM programs were also projected. The ridership and utilization projections are summarized in Tables 3.7-1 through 3.7-4 and are described below for each alternative. The tables also include the number of vehicles diverted from the Spaulding Turnpike between Exit 3 and Exit 6 (across the Little Bay Bridges) and the resultant effect of these diversions on roadway level of service. Analyses were conducted for four scenarios: the existing 4-lane Turnpike and Little Bay Bridge

facility under no-build conditions (Table 3.7-1); the existing facility with the use of the General Sullivan Bridge as an exclusive busway (Table 3.7-2); a 6-lane (three lanes southbound and three lanes northbound) facility (Table 3.7-3); and an 8-lane (four lanes southbound and four lanes northbound) facility (Table 3.7-4). Under the 6-lane build scenario, bus ridership was projected assuming use of an HOV facility for bus operations.

The traffic volumes across the Little Bay Bridges used in the level of service analyses for No-Build conditions in Tables 3.7-1 through 3.7-4 represent total 2025 peak hour travel demand. These no-build volumes represent the total desire for travel along the roadway in the peak hour and exceed the peak hour capacity of the 4-lane roadway. As described in Section 2.2.1, the No-Build alternative is not considered a viable alternative, but serves as a baseline condition for comparison to other alternatives. Although the No-Build volumes are not limited by the roadway capacity, they are somewhat reduced from build volumes because of no-build capacity constraints. These capacity constraints result in some shifting of traffic to alternative routes by the travel demand model, but these shifts are not large enough to reduce demand to a level equal to roadway capacity. Actual roadway volumes under No-Build conditions are expected to be closer to roadway capacity as many drivers will shift travel to non peak hour times to avoid congestion and long delays. **Figures 2.2-1 and 2.2-2** presented earlier illustrate this expected peak hour spreading.

Table 3.7-1
2025 Level of Service Summary on Little Bay Bridges, Non-SOV Alternatives Ridership and Roadway Volumes for Four-Lane No-Build Condition

Alternative	Morning Peak Hour Southbound				Evening Peak Hour Northbound			
	Ridership/ Utilization	Diverted Vehicles[1]	Volume[2] with Diversions	LOS	Ridership/ Utilization	Diverted Vehicles[1]	Volume[2] with Diversions	LOS
Existing (2003) – with no non-SOV Alternatives	N/A	N/A	4,025	E	N/A	N/A	4,070	E
No-Build (2025) – with no non-SOV Alternatives	N/A	N/A	4,747	F	N/A	N/A	5,087	F
TDM Program – Moderate[3]	178	178	4,569	F	178	178	4,909	F
TDM Program – Aggressive[3]	311	311	4,436	F	311	311	4,776	F
Bus Alternative 1 – Rochester to Boston[4]	37	31	4,716	F	37	31	5,056	F
Bus Alternative 2 – Rochester to PTC Express[4,5]	18	15	4,732	F	18	15	5,072	F
Bus Alternative 3 – Rochester to Portsmouth Enhanced Local[4]	46	39	4,708	F	46	39	5,048	F
Rail Alternative 1A – Expanded Downeaster Service from Dover[6]	71	59	4,688	F	71	59	5,028	F
Rail Alternative 1B – Expanded Downeaster Service from Rochester[6]	99	82	4,665	F	99	82	5,005	F
Rail Alternative 2A – Rochester to Portsmouth via Rockingham Junction	33	27	4,720	F	33	27	5,060	F
Rail Alternative 2B – Rochester to Portsmouth via Turnpike Corridor	158	131	4,616	F	158	131	4,956	F
Combination 1 -- Aggressive TDM and Bus Alts. 1-3	373	363	4,384	F	373	363	4,724	F
Combination 2 -- Aggressive TDM, Bus Alts. 1-3, and Rail Alt. 1B	441	419	4,328	F	441	419	4,668	F

1. The number of diverted vehicles for the bus and rail alternatives equals the projected ridership divided by an average vehicle occupancy rate of 1.2 persons per vehicle.
2. No-build volume represents total peak hour travel demand. Actual roadway volumes under no-build conditions are expected to be closer to roadway capacity because many drivers will alter travel behavior to avoid congestion and delays.
3. The Moderate and Aggressive TDM Programs are projected to result in a 4 and 7 percent reductions, respectively, in work trips to Portsmouth, Pease, Kittery, and Boston.
4. All Bus Alternatives assume use of general purpose lanes on Turnpike.
5. Bus Alternative 2 ridership is based on COAST's CMAQ application for the Spaulding Turnpike Express. Peak hour ridership is net additional trips from adding one peak period bus to provide 25-minute headways throughout most of the peak period.
6. Downeaster ridership includes existing ridership.

Table 3.7-2
2025 Level of Service Summary on Little Bay Bridges, Non-SOV Alternatives Ridership and Roadway Volumes for Four-Lanes with Busway on General Sullivan Bridge

Alternative	Morning Peak Hour Southbound				Evening Peak Hour Northbound			
	Ridership/ Utilization	Diverted Vehicles[1]	Volume[2] with Diversions	LOS	Ridership/ Utilization	Diverted Vehicles[1]	Volume[2] with Diversions	LOS
Existing (2003) – with no non-SOV Alternatives	N/A	N/A	4,025	E	N/A	N/A	4,070	E
No-Build (2025) – with no non-SOV Alternatives	N/A	N/A	4,747	F	N/A	N/A	5,087	F
TDM Program – Moderate[3]	178	178	4,569	F	178	178	4,909	F
TDM Program – Aggressive[3]	311	311	4,436	F	311	311	4,776	F
Bus Alternative 1 – Rochester to Boston[4]	57	47	4,700	F	57	47	5,040	F
Bus Alternative 2 – Rochester to PTC Express[4,5]	35	29	4,718	F	35	29	5,058	F
Bus Alternative 3 – Rochester to Portsmouth Enhanced Local[4]	75	62	4,685	F	75	62	5,025	F
Rail Alternative 1A – Expanded Downeaster Service from Dover[6]	71	59	4,688	F	71	59	5,028	F
Rail Alternative 1B – Expanded Downeaster Service from Rochester[6]	99	82	4,665	F	99	82	5,005	F
Rail Alternative 2A – Rochester to Portsmouth via Rockingham Junction	33	27	4,720	F	33	27	5,060	F
Rail Alternative 2B – Rochester to Portsmouth via Turnpike Corridor	158	131	4,616	F	158	131	4,956	F
Combination 1 -- Aggressive TDM and Bus Alts. 1-3	409	393	4,354	F	409	393	4,694	F
Combination 2 -- Aggressive TDM, Bus Alts. 1-3, and Rail Alt. 1B	467	441	4,306	F	467	441	4,646	F

1. The number of diverted vehicles for the bus and rail alternatives equals the projected ridership divided by an average vehicle occupancy rate of 1.2 persons per vehicle.
2. No-build volume represents total peak hour travel demand. Actual roadway volumes under no-build conditions are expected to be closer to roadway capacity because many drivers will alter travel behavior to avoid congestion and delays.
3. The Moderate and Aggressive TDM Programs are projected to result in a 4 and 7 percent reductions, respectively, in work trips to Portsmouth, Pease, Kittery, and Boston.
4. All Bus Alternatives assume use of the General Sullivan Bridge as a busway with local roadway upgrades to provide busway connections.
5. Bus Alternative 2 ridership is based on COAST's CMAQ application for the Spaulding Turnpike Express. Peak hour ridership is net additional trips from adding one peak period bus to provide 25-minute headways throughout most of the peak period.
6. Downeaster ridership includes existing ridership.

Table 3.7-3
2025 Level of Service Summary on Little Bay Bridges, Non-SOV Alternatives Ridership and Roadway Volumes for Six-Lane Build Condition

Alternative	Morning Peak Hour Southbound				Evening Peak Hour Northbound			
	Ridership/ Utilization	Diverted Vehicles[1,2]	Volume[3] with Diversions	LOS	Ridership/ Utilization	Diverted Vehicles[1,2]	Volume[3] with Diversions	LOS
Existing (2003) – with no non-SOV Alternatives	N/A	N/A	4,025	E	N/A	N/A	4,070	E
No-Build (2025) – with no non-SOV Alternatives	N/A	N/A	4,747	F	N/A	N/A	5,087	F
Build (2025) – with no non-SOV Alternatives	N/A	N/A	5,317	E	N/A	N/A	5,497	E
HOV Lane Alt. A – Toll Plaza to I-95	185	216	5,102	E	204	238	5,259	E
HOV Lane Alt. B – Toll Plaza to Exit 1	320	373	4,944	D	296	345	5,152	E
TDM Program – Moderate[4]	199	199	5,118	E	199	199	5,298	E
TDM Program – Aggressive[4]	348	348	4,969	D	348	348	5,149	E
Bus Alternative 1 – Rochester to Boston[5]	28	23	5,294	E	28	23	5,474	E
Bus Alternative 2 – Rochester to PTC Express[5,6]	18	15	5,302	E	18	15	5,482	E
Bus Alternative 3 – Rochester to Portsmouth Enhanced Local[5]	26	21	5,296	E	26	21	5,476	E
Rail Alternative 1A – Expanded Downeaster Service from Dover[7]	47	39	5,278	E	47	39	5,458	E
Rail Alternative 1B – Expanded Downeaster Service from Rochester[7]	66	55	5,262	E	66	55	5,442	E
Rail Alternative 2A – Rochester to Portsmouth via Rockingham Junction	6	5	5,312	E	6	5	5,492	E
Rail Alternative 2B – Rochester to Portsmouth via Turnpike Corridor	27	22	5,295	E	27	22	5,475	E
Combination 1 -- Aggressive TDM and Bus Alts. 1-3	395	387	4,930	D	395	387	5,110	E
Combination 2 -- Aggressive TDM, Bus Alts. 1-3, and Rail Alt. 1B	461	421	4,896	D	461	421	5,076	E
Combination 3 – Combination 2 plus HOV Alt. B	781	794	4,523	D	757	766	4,731	D
Combination 4 – Combination 1 plus HOV Alt. B	715	760	4,557	D	691	732	4,765	D

1. The number of diverted vehicles for the bus and rail alternatives equals the projected ridership divided by an average vehicle occupancy rate of 1.2 persons per vehicle.
2. The number of diverted vehicles for the HOV alternatives includes HOVs already in the traffic stream plus twice the number of induced HOVs. Two SOVs are eliminated for each HOV created.
3. No-build volume represents total peak hour travel demand. Actual roadway volumes under no-build conditions are expected to be closer to roadway capacity because many drivers will alter travel behavior to avoid congestion and delays.
4. The Moderate and Aggressive TDM Programs are projected to result in a 4 and 7 percent reductions, respectively, in work trips to Portsmouth, Pease, Kittery, and Boston.
5. All Bus Alternatives assume use of an HOV facility between the Toll Plaza and Exit 1.
6. Bus Alternative 2 ridership is based on COAST's CMAQ application for the Spaulding Turnpike Express. Peak hour ridership is net additional trips from adding one peak period bus to provide 25-minute headways throughout most of the peak period.
7. Downeaster ridership includes existing ridership.

Table 3.7-4
2025 Level of Service Summary on Little Bay Bridges, Non-SOV Alternatives Ridership and Roadway Volumes for Eight-Lane Build Condition

Alternative	Morning Peak Hour Southbound				Evening Peak Hour Northbound			
	Ridership/ Utilization	Diverted Vehicles[1]	Volume[2] with Diversions	LOS	Ridership/ Utilization	Diverted Vehicles[1]	Volume[2] with Diversions	LOS
Existing (2003) – with no non-SOV Alternatives	N/A	N/A	4,025	E	N/A	N/A	4,070	E
No-Build (2025) – with no non-SOV Alternatives	N/A	N/A	4,747	F	N/A	N/A	5,087	F
Build (2025) – with no non-SOV Alternatives	N/A	N/A	5,447	D	N/A	N/A	5,792	D
TDM Program – Moderate[3]	204	204	5,243	D	204	204	5,588	D
TDM Program – Aggressive[3]	357	357	5,090	D	357	357	5,435	D
Bus Alternative 1 – Rochester to Boston[4]	26	22	5,425	D	26	22	5,770	D
Bus Alternative 2 – Rochester to PTC Express[4,5]	18	15	5,432	D	18	15	5,777	D
Bus Alternative 3 – Rochester to Portsmouth Enhanced Local[4]	21	18	5,429	D	20	17	5,775	D
Rail Alternative 1A – Expanded Downeaster Service from Dover[6]	39	23	5,424	D	39	23	5,769	D
Rail Alternative 1B – Expanded Downeaster Service from Rochester[6]	55	46	5,401	D	55	46	5,746	D
Rail Alternative 2A – Rochester to Portsmouth via Rockingham Junction	3	2	5,445	D	3	2	5,790	D
Rail Alternative 2B – Rochester to Portsmouth via Turnpike Corridor	14	11	5,436	D	14	11	5,781	D
Combination 1 -- Aggressive TDM and Bus Alts. 1-3	390	385	5,062	C	390	385	5,407	D
Combination 2 -- Aggressive TDM, Bus Alts. 1-3, and Rail Alt. 1B	420	410	5,037	C	420	410	5,382	D

1. The number of diverted vehicles for the bus and rail alternatives equals the projected ridership divided by an average vehicle occupancy rate of 1.2 persons per vehicle.
2. No-build volume represents total peak hour travel demand. Actual roadway volumes under no-build conditions are expected to be closer to roadway capacity because many drivers will alter travel behavior to avoid congestion and delays.
3. The Moderate and Aggressive TDM Programs are projected to result in a 4 and 7 percent reductions, respectively, in work trips to Portsmouth, Pease, Kittery, and Boston.
4. All Bus Alternatives assume use of general purpose lanes on Turnpike.
5. Bus Alternative 2 ridership is based on COAST's CMAQ application for the Spaulding Turnpike Express. Peak hour ridership is net additional trips from adding one peak period bus to provide 25-minute headways throughout most of the peak period.
6. Downeaster ridership includes existing ridership.

Existing delay on the Turnpike through the study area is approximately eight minutes based on travel time runs conducted for this study. This delay represents the difference between the average travel time with no congestion and the average travel time under congested conditions. Based on the travel demand model output, this delay is projected to increase to about 20 minutes under the 2025 no-build condition. Under the 6-lane build alternative the delay is expected to decrease to about five minutes under 2025 traffic conditions. This is less than the existing delay because the flow rate per lane under the 6-lane alternative is less than under the 4-lane existing condition. The 8-lane build scenario does not include any significant vehicle delay along the Spaulding Turnpike because the Turnpike is projected to operate at LOS D or better. Level of Service D operations allow traffic to operate at free flow speed.

Figure 3.2-2 presented earlier shows a possible cross section for a 6-lane alternative that would provide for a temporary contraflow or "zipper" lane. This configuration could allow the 6-lane alternative to provide the same capacity in the peak direction in peak periods as the 8-lane alternative. The zipper lane would be comprised of two moveable barriers against either side of the median. The moveable barrier on one side of the highway could be shifted toward the outside of the roadway by one lane, and the inside lane could be used to accommodate general traffic traveling in the opposite direction. The moveable barrier would separate the opposing flows. For example, in the evening peak period, the moveable barrier on the southbound side of the highway would be moved between the inside and middle lanes. The inside southbound lane would then be opened to northbound traffic. As a result, the roadway would provide four lanes in the peak northbound direction and two lanes in the off-peak southbound direction. In the morning peak period the configuration would be reversed. In off-peak times, the moveable barriers would be stored against the median allowing three lanes to move in each direction. The ridership analyses presented below for the 8-lane build alternative would approximate the use of a zipper lane with the 6-lane cross section.

3.7.1 Rail

Rail Alternative 1A (Expanded Downeaster Service from Dover)

Rail Alternative 1A would expand existing Downeaster train service from Dover and Durham to Boston by providing an additional peak period train. Rail travel time from Dover to Boston is estimated to be approximately 1 hour 40 minutes, while driving time is estimated to be approximately 1 hour and 55 minutes under No-build conditions. This includes a 20-minute delay for congestion on the Spaulding Turnpike under no-build conditions. The 20-minute delay for travel along the Turnpike is based on changes in travel time projected by the model and the existing delay of almost eight minutes observed during travel time runs conducted in June 2004. The monthly fare from Dover would be $257.00, or $6.12 per one-way trip.

For the no-build scenarios, the projected peak hour ridership of 71 passengers would result in the diversion of about 59 vehicles from the Spaulding Turnpike. This number of diverted vehicles is not sufficient to result in an improved roadway level of service. This projected ridership includes current boardings at Dover and Durham. Peak hour ridership is projected to be approximately 47 under the 6-lane build scenario and 39 under the 8-lane build scenario. These are less than under the no-build scenarios because a 6- or 8-lane facility will operate with less congestion and delay. The 8-lane scenario will experience no significant delay.

Rail Alternative 1B (Expanded Downeaster Service from Rochester)

Rail Alternative 1B would extend the expanded Downeaster service described in Rail Alternative 1A to Rochester. Alternative 1B supplements the existing service from Dover and Durham to Boston with an additional peak period train that also services Rochester. Rail travel time from Rochester to Boston is expected to be about 1 hour and 50 minutes, while driving time from Rochester to Boston is estimated to be approximately 2 hours and 5 minutes, including the 20-minute delay for congestion on the Spaulding Turnpike under no-build conditions. The monthly fare from Rochester would be $289.00, or $6.88 per one-way trip.

The projected peak hour ridership for this service is 99 passengers under the no-build scenarios. This results in a diversion of about 82 vehicles from Spaulding Turnpike in the peak hour which is not sufficient to result in an improved roadway level of service. Under the 6- and 8-lane build alternatives, peak hour ridership is projected to be approximately 66 and 55 passengers, respectively. As with Alternative 1A, the ridership projections include existing boardings in Dover and Durham.

Rail Alternative 2A (Rochester to Portsmouth via Rockingham Junction)

Rail Alternative 2A would provide new rail service between Rochester and Portsmouth via Dover, Durham, Rockingham Junction and the Portsmouth Transportation Center using existing rail infrastructure. Rail travel time from Rochester to Portsmouth would be approximately 60 minutes, while driving time is estimated to be approximately 46 minutes, including the 20-minute delay for congestion on the Spaulding Turnpike under no-build conditions. The monthly fare from Rochester would be $170.00, or $4.05 per one-way trip. The projected peak hour ridership for this alternative under the no-build scenarios is 33 passengers, resulting in a diversion of about 27 vehicles from Spaulding Turnpike. This number of diverted vehicles is not sufficient to result in an improved roadway level of service. The projected peak hour ridership under the 6- and 8-lane build alternatives is approximately 6 and 3 passengers, respectively. With limited or no vehicle delay along the Spaulding Turnpike, this alternative has little attraction to commuters because of its relatively long travel time.

Rail Alternative 2B (Rochester to Portsmouth via the Turnpike Corridor)

Rail Alternative 2B would provide new rail service between Rochester and Portsmouth via the Spaulding Turnpike corridor with stops in Dover and at Gosling Road. Rail travel time from Rochester to Portsmouth would be approximately 45 minutes, while driving time is estimated to be approximately 46 minutes, including the 20-minute delay for congestion on the Spaulding Turnpike under no-build conditions. The monthly fare from Rochester would be $170.00, or $4.05 per one-way trip. This alternative generates the largest ridership of any of the rail or bus alternatives. Projected peak hour ridership for this alternative under the no-build scenarios is approximately 158 passengers. This would result in a reduction of about 131 vehicles in the peak hour. This number of diverted vehicles would not improve levels of service on the Spaulding Turnpike. The projected peak hour ridership for the 6- and 8-lane build scenarios is approximately 27 and 14 passengers, respectively.

3.7.2 Bus

The projected ridership for the bus alternatives for the no-build and 8-lane build scenarios is based on the bus operating in the general purpose lanes. For the no-build with busway scenario, the buses are assumed to use the busway on the General Sullivan Bridge. For the 6-lane scenario, the projected ridership is based on the bus operating in an HOV lane between the toll plaza and Exit 1. Because roadway congestion on the Turnpike is greatly reduced under the 6-lane scenario, bus ridership is lower than under either no-build scenario. Under the 8-lane scenario, bus ridership is even lower because ample capacity is provided and projected LOS D operations on the Turnpike permit travel at free flow speed, resulting in no significant delay.

Bus Alternative 1 (Rochester to Boston)

Bus Alternative 1 would provide service similar to the current C&J Trailways service, with a Rochester stop added and the Newburyport stop removed. Bus travel time from Rochester to Boston is approximately 2 hours and 15 minutes, while driving time is approximately 2 hours and 5 minutes, including the 20-minute delay for congestion on Spaulding Turnpike under no-build conditions. A ten-ride pass would be $76.00, or $7.60 per one-way trip (C&J Trailways does not currently offer a monthly pass). The projected ridership for this alternative is approximately 37 passengers under the no-build scenario and approximately 57 passengers under the no-build scenario with a busway on the General Sullivan Bridge. The projected ridership would result in peak hour diversion of approximately 31 and 47 vehicles, respectively. These diversions would not improve levels of service on the Spaulding Turnpike. The projected ridership for the 6- and 8-lane scenarios would be approximately 28 and 26 passengers, respectively.

Bus Alternative 2 (Rochester to Portsmouth)

Bus Alternative 2 would provide an expansion of the planned COAST Rochester-to-Portsmouth Spaulding Turnpike Express service. An additional peak period bus would be added to provide 25-minute headways throughout most of the peak period. Bus travel time from Rochester to the Portsmouth Transportation Center is approximately 1 hour, while driving time is approximately 46 minutes, including an assumed 20-minute delay for congestion on the Spaulding Turnpike under no-build conditions. The monthly fare from Rochester and Dover would be $52.00, or $1.24 per one-way trip. The projected ridership for increasing service is approximately 18 passengers under no-build conditions without the busway on the General Sullivan Bridge and 35 passengers with the busway. These would result in a diversion of approximately 15 and 29 vehicles, respectively, from the Spaulding Turnpike in the peak hour. This number of diverted vehicles would not improve levels of service on the Spaulding Turnpike. The projected ridership is approximately 18 passengers under both the 6- and 8-lane scenarios. The projection of ridership for this service is based on ridership projections included in COAST's CMAQ application for the Spaulding Turnpike Express. The base ridership (70) is accounted for in the 2025 No-Build and Build with no non-SOV Alternatives (Tables 3.7-1 through 3.7-4).

Bus Alternative 3 (Expanded Local Service)

Bus Alternative 3 would provide expanded local service through improvements to headways on the COAST Route 2, the COAST Pease Tradeport Trolley, and the Wildcat Transit Route 4. These service improvements would be supplemented by new park-and-ride facilities in Rochester, Dover and Durham. This alternative would improve or provide service to all major employment centers in the area, including the Tradeport, downtown Portsmouth, and Woodbury Avenue. The monthly fare would be $35.00, or $0.83 per one-way trip. Projected peak hour ridership for this alternative is approximately 46 passengers under the no-build scenario and 75 passengers under the no-build scenario with the busway on the General Sullivan Bridge. These projections would result in the diversion approximately 39 and 62 vehicles, respectively, in the peak hour. This number of diverted vehicles would not improve levels of service on the Spaulding Turnpike. Projected ridership with the 6- and 8-lane scenarios is approximately 26 and 21, respectively.

3.7.3 HOV Lanes

As stated previously, the physical configuration of the HOV alternatives (*e.g.* single or dual contraflow lanes, or single concurrent flow lanes) did not affect the ridership projections. The alternatives, as conceptually depicted in **Figures 3.2-1 and 3.2-2**, differ only in width of roadway cross section and termini for beginning and ending of lane usage. The HOV alternatives were analyzed for the 6-lane build scenario only. The no-build scenarios do not include any improvements to the Spaulding Turnpike. Under the 8-lane build scenario, there would be no advantage to providing an HOV facility because there would be no significant travel time delays.

HOV Alternative A

HOV Alternative A would provide an HOV lane between the Dover Toll Plaza and I-95 (with no access to and from Exit 1). Based on the 2025 travel demand model, approximately 154 HOVs are projected to be traveling southbound between the toll plaza and I-95 in the morning peak hour and approximately 170 HOVs are projected to be traveling northbound in the evening peak hour between I-95 and the toll plaza. A travel delay of about 5 minutes is projected along the corridor under the 6-lane build alternative based on the travel demand model. Because the HOV lane runs the entire length of the study corridor, it would provide a travel time savings of approximately 5 minutes. Based on this travel time saving, HOV volumes could be expected to increase by approximately 20 percent. With such an increase, the volume in the HOV lane would be approximately 185 vehicles in the morning peak hour and 204 vehicles in the evening peak hour. This increase in HOV volume would result in the reduction of 31 and 34 vehicles in the total roadway volume for the morning and evening peak hours, respectively. These reductions represent SOV drivers joining other drivers to create new carpools.

Approximately 216 and 238 vehicles would be diverted from the general purpose lanes in the morning and evening peak hours, respectively, under the 6-lane build scenario. This diversion estimate assumes that all HOVs use the HOV lane and that two SOVs are eliminated from the general purpose lanes for each HOV created because of the availability of the HOV lane. These diversions would not change projected levels of service in either the morning or the evening peak hour when the roadway would continue to operate at LOS E. Operating conditions in the three general purpose lanes with an HOV lane would be lower than they would be with four general purpose lanes where all traffic would operate at LOS D.

The projected HOV lane volumes fall short of the threshold of 800 vehicles per hour considered necessary to justify installing an HOV facility. The 800-vehicle threshold is based on the assumption that an HOV lane should provide a good level of service to as many people as a general purpose lane could. Assuming a minimum vehicle occupancy rate of two persons per vehicle, 800 vehicles would serve at least 1,600 persons, making its utilization comparable to that of a well utilized SOV lane.

HOV Alternative B

Alternative B was identified to extend between the Dover Toll Plaza and north of Exit 1. This would allow HOVs from the Spaulding Turnpike to reach either Exit 1 (Pease Tradeport) or I-95 but would not accommodate HOVs from US 4. Based on the 2025 travel demand model, approximately 267 HOVs are projected to travel southbound in the morning peak hour and approximately 247 HOVs are projected to travel northbound in the evening peak hour between Exit 1 and the toll plaza. As noted above, a travel delay of about 5 minutes is projected along the corridor under the 6-lane build alternative. Because the HOV lane under this alternative does not run the entire length of the study corridor, it would provide a travel time savings of less than

5 minutes. Based on this travel time saving, HOV volumes could be expected to increase no more than 20 percent. With such an increase, the volume in the HOV lane would be approximately 320 vehicles in the morning peak hour and 296 vehicles in the evening peak hour. These volumes fall short of the 800-vehicle threshold considered necessary to justify installing such a facility.

The projected diversions of traffic from the general purpose lanes to the HOV lanes are based on the assumptions that all HOVs use the HOV lane and that two SOVs are eliminated from the general purpose lanes for each HOV created because of the availability of the HOV lane. Approximately 373 and 345 vehicles, respectively, would be diverted from the southbound general purpose lanes in the morning peak hour and from the northbound general purpose lanes in the evening peak hour. These diversions would improve traffic level of service on the Spaulding Turnpike from LOS E to LOS D for the morning peak hour but would continue LOS E operations in the evening peak hour.

HOV Alternative C

HOV Alternative C would extend from south of Exit 6 to north of Exit 1. This configuration would maximize the number of HOVs which would have access to the HOV lane by making it accessible to U.S. 4 and the Spaulding Turnpike on the north and I-95 and Exit 1 (Pease Tradeport) on the south. However, this configuration cannot be physically accommodated because there is inadequate distance between the Exit 6 southbound on- and northbound off-ramps and the north end of the Little Bay Bridges. Insufficient spacing exists to safely allow weaving movements for vehicles entering the lane from US 4 (Exit 6W southbound on-ramp) or for vehicles exiting the lane to reach the off-ramp to US 4 (Exit 6W northbound off-ramp). No ridership projections are presented for this HOV alternative because of the physical constraints on its implementation.

3.7.4 TDM

Based on the EPA COMMUTER model, the moderate and aggressive TDM programs are projected to generate reductions of 4 percent and 7 percent, respectively, in work trips to areas with the programs. These reductions were applied to projected 2025 work trips between Strafford County and the Pease Tradeport, downtown Portsmouth, and downtown Boston. The moderate TDM program is expected to eliminate between 178 and 204 respective AM and PM peak hour vehicles on Spaulding Turnpike while the aggressive TDM program is projected to eliminate between 311 and 357 respective AM and PM peak hour trips. These diversions will not change level of service on, Spaulding Turnpike under the no-build and 8-lane build scenarios. Under the 6-lane build scenario the aggressive TDM program would improve traffic operations from LOS E to LOS D in the morning peak hour. Neither program would improve traffic operations (LOS E) in the evening peak hour.

3.7.5 Combined Alternatives

A preliminary analysis of the possible effect of combining alternatives was conducted. Four combinations were considered. The first included the Aggressive TDM Program along with all three bus alternatives. The second combination built on the first and added Rail Alternative 1B (Expanded Downeaster Service to Rochester). The third combination added HOV Alternative B to the second combination. This combination would only occur under the 6-lane build scenario. The fourth combination added Alternative B to Combination 1. The only difference between Combinations 3 and 4 is that Combination 4 does not include Rail Alternative 1B.

Combination 1 resulted in a total diversion of between about 363 and 393 vehicles. This combination results in no change in level of service under the two no-build scenarios, the 6-lane build scenario in the evening peak hour and the 8-lane build scenario in the evening peak hour. It improves operations under the 6-lane build scenario to LOS D in the morning peak hour, and improves operations to LOS C in the morning peak hour under the 8-lane build condition. Combination 2 would divert between about 410 and 441 trips or an additional approximately 48 trips. The Combination 2 diversions would have the same impact on levels of service as the Combination 1 diversions. Combination 3 has the largest impact. It adds HOV Alternative B and occurs only under the 6-lane build scenario. Under this scenario it diverts between about 766 and 794 vehicles. These diversions would improve levels of service to LOS D in both peak hours. Combination 4 which is the same as Combination 3 except that it does not include Rail Alternative 1B results in the diversion of 32 (evening peak hour) to 34 (morning peak hour) fewer vehicles than Combination 3. As with Combination 3, the diversions resulting from Combination 4 would improve levels of service to LOS D in both peak hours.

It should be noted that in combining bus and rail alternatives duplications in ridership were eliminated. Therefore, the total transit ridership under the combination alternatives is less than the total of the ridership reported individually for the bus and rail alternatives. In aggregating transit and HOV alternatives under the 6-lane build scenario, an overestimation of traffic diversion likely occurs because the HOV and transit alternatives compete for the same commuter market. Commuters who might be attracted to transit might also be attracted to a ridesharing. No information is available regarding the extent of double counting that might occur in aggregating the projections for transit and HOV use.

3.7.6 Sensitivity Analysis

A test of the sensitivity of the ridership projections to a change in the vehicle operating cost parameter was conducted. The purpose was to test the impact of a rise in the price of gasoline to $3.00 per gallon and to test a change in the assumption about using only marginal or operating cost for vehicle cost. The analysis uses operating cost (gas, oil, tires, and maintenance) for calculating the cost per mile of

using a vehicle. This approach assumes no commuters will be able to eliminate the ownership of a vehicle. A sensitivity test was conducted to determine the impact of assuming 10 percent of commuters would save the full cost of owning a vehicle. Incorporating this assumption adds about $0.06 per mile to the vehicle cost. Accounting for a possible increase in the cost of gasoline to $3.00 per gallon adds another $0.05 per mile. The sensitivity test was conducted using a vehicle cost of $0.27 per mile or $0.11 per mile more than the original $0.16 per mile cost used in the ridership analysis.

The test was conducted on Rail Alternative 2B under the No-Build condition because it generates the highest ridership of the transit alternatives. At $0.16 per mile for vehicle cost, Rail Alternative 2B generates approximately 158 passengers and a diversion of 131 vehicles. Using a vehicle cost of $0.27 per mile results in a projected ridership of approximately 260 passengers and a diversion of 217 vehicles. This represents about 102 more passengers and an increased diversion of almost 86 vehicles in the peak hour. This increased diversion is not large enough to have a significant impact on roadway operating conditions.

3.8 Summary

Based on the preliminary analyses summarized in Tables 3.7-1 through 3.7-4, there is a wide range of potential peak hour diversions of SOVs from the study area due to the provision of bus, rail, HOV, and TDM alternatives. Under the no-build scenarios (with and without a busway on the General Sullivan Bridge) and the 8-lane build scenario, no alternative changes traffic level of service in either AM or PM peak hour. Under the 6-lane build scenario, only HOV Alternative B, the Aggressive TDM program, and the four Combination alternatives improve morning level of service from LOS E to LOS D. Except for Combinations 3 and 4, none of the alternatives improves level of service in the evening peak hour. Combinations 3 and 4 improve level of service from LOS E to LOS D.

It should be noted that the diversions for Combination Alternatives 3 and 4 are likely to be overstated because the transit modes often serve the same market as ridesharing programs. No information is available regarding the extent of duplication in ridership projections for the transit and the HOV alternatives.

It should also be noted that while traffic level of service on the Little Bay bridges is indicative of the potential traffic volume decrease due to the provision of alternative modes, overall study area safety conditions and traffic operations will be governed by traffic weaving and merging maneuvers at the interchange areas, especially Exits 3 and 6, which are not reflected in the level of service and capacity calculation at the Little Bay Bridges.

3.8.1 Rail Alternatives

The conceptual rail alternatives were developed to address two complementary goals: diverting automobile trips to passenger rail service, and diverting freight traffic from truck to rail. Both goals work to address congestion on the Spaulding Turnpike. The following sections discuss the degree to which the rail alternatives meet the goals of attracting passenger ridership and diverting freight traffic, respectively.

Attracting Passenger Ridership

The rail alternatives all facilitate passenger rail service in and around the study area, offering the potential to attract ridership and divert automobile trips to passenger rail service. However, some of the alternatives achieve this goal more effectively than others, while some have significantly larger infrastructure and equipment requirements and capital costs than others. The alternatives to be carried forward for further analysis in the DEIS should have the greatest potential to divert automobile trips to passenger rail with the smallest infrastructure requirements, capital cost, and impact on the environment and private property.

Rail Alternative 1, which would expand the existing *Downeaster* service to better serve commuters in the Dover and Rochester vicinity, is the most viable of the rail alternatives. Although the projected ridership and trip diversions in this alternative are modest in the short term, it builds on an existing intercity rail service and improves its viability, suggesting the potential for further ridership gains in the future. If the infrastructure requirements for this alternative are limited to construction of station stops and a layover facility and do not include double-tracking of the Main Line West, the capital costs of the alternative with a Dover terminus (Alternative 1A) range from $9.9 to $13.6 million, depending on the type of equipment used (DMUs vs. traditional locomotive-hauled consists). Extending the service to Rochester (Alternative 1B) would cost $10.3 - $14.0 million, depending on type of equipment. It is also worth noting that NNEPRA is currently in the process of conducting business planning activities for the *Downeaster* service, which include consideration of opportunities for service growth and expansion; Rail Alternatives 1A and 1B could fit into these plans. For these reasons, it is recommended that Rail Alternatives 1A and 1B be carried forward for further analysis in the DEIS.

Rail Alternative 2, which included several alignment and mode options, would provide passenger rail service for commuters from Rochester and Dover to Portsmouth. The ridership projections for all of the options under this alternative are relatively small, less than 160 trips per peak hour in the peak direction. The infrastructure requirements associated with this alternative would be substantial, involving the construction or reconstruction of a number of miles of track and numerous bridges and grade crossings, and construction or modifications at a number of stations. Based on the high capital costs of these infrastructure improvements ($134 million – $176 million) and the relatively low ridership expected

on the services, it is recommended that Rail Alternative 2 not be pursued for further study.

Rail Alternative 3, which would establish passenger service on the Conway Branch, is expected to attract very few riders who would otherwise travel on the Spaulding Turnpike in the study area. The infrastructure requirements associated with reconstructing the 22-mile abandoned segment of the line between Ossipee and Conway are substantial, particularly the incremental cost ($12.2 million) of upgrading the rail to a condition which would allow an attractive passenger service. The NHDOT has recently completed a Feasibility Study for rehabilitation of the abandoned section of the Conway Branch, which identified a possible incremental approach to restoration. This approach may be feasible for attracting a passenger base and funding improvements over the long term, but it would have no measurable effect on the Spaulding Turnpike corridor in the study area. Therefore, it is recommended that Rail Alternative 3 not be pursued for further study.

Diversion of Freight from Truck to Rail

The movement of freight by truck contributes to the overall traffic volumes and congestion levels on the Spaulding Turnpike within the study area. Currently the vast majority of freight moves through the corridor by truck. If a substantial volume of freight could be diverted from truck to rail, it might be possible to reduce congestion levels on the Spaulding Turnpike within the study area. Several of the rail alternatives could improve the freight rail infrastructure and thereby make freight transportation more effective. However, some of the alternatives achieve this goal more effectively than others, while some have considerably larger infrastructure requirements and capital costs than others. The alternatives to be carried forward for further analysis in the DEIS should have the greatest potential to divert freight from truck to rail with the smallest infrastructure requirement, capital cost, and impact on the environment and private property.

The characteristics of the freight demand must be conducive to rail transportation for freight traffic to be successfully diverted from truck to rail. Freight rail is best suited to transporting goods over long distances; moving bulk commodities or goods; and transporting shipments that are not extremely time-sensitive. In New Hampshire, 85 percent of rail traffic originating within the state by volume consists of non-metallic minerals. Likewise, 75 percent of the traffic terminating within the state consists of coal and petroleum. The New Hampshire Northcoast Railroad is an example of a freight railroad that has found a market that is conducive to rail transportation – carrying gravel from Ossipee Aggregates along the Conway Branch to a processing center in Boston. If New Hampshire Northcoast were not operating this service, a substantial number of trucks would be added to the Spaulding Turnpike study corridor, contributing to the congestion problem.

In the context of the Newington-Dover project, the freight market within the study area is generally not conducive to transportation by rail at the present time. The

study area is comprised mainly of light industrial uses and retail businesses that either ship or receive small quantities of goods at any one time. The retail establishments receive their shipments from large distribution centers that are centrally located. Their distribution networks to retail locations are set up for delivery by truck. The largest potential users of freight rail service are the Public Service of New Hampshire (PSNH) power plants located on the Newington Branch in Newington and Portsmouth. Plans are underway to convert the PSNH Schiller plant in Portsmouth from coal fired to wood chip fired boilers An ongoing study is examining the economics of shipping the wood chips to the Schiller plant by rail rather than truck.

In areas to the north of the study area, including municipalities located along the Conway Branch, there are a number of existing businesses that transport goods that could potentially be carried by rail. These businesses include propane distribution, lumber yards, and wood chip operations. The restoration of the Conway Branch to permit freight operations, as proposed in the NHDOT Conway Branch Feasibility Study, could help make freight rail a viable option for these and other businesses along the Route 16 corridor. However, the upgrade of the Conway Branch as proposed in Rail Alternative 3 is more difficult to justify due to the capital cost of the upgrade and the modest passenger ridership anticipated on the line. Therefore, it is recommended that Rail Alternative 3 not be pursued for further study.

The Pease Tradeport, located to the west of the Spaulding Turnpike in Newington, is a potential location for development of industrial and commercial businesses. This area could be served by freight rail if the short spur between the Tradeport and the existing Newington Branch freight rail line were re-established, as is proposed in Rail Alternative 4. While such a connection is not likely to be used in the short-term, it may be viable in the long-term and is included in the *Pease Surface Transportation Master Plan*. Therefore, the highway alternatives recommended to be carried forward into the DEIS preserve a rail right-of-way and establish a grade-separated crossing to allow the future redevelopment of a freight rail connection to the Tradeport.

3.8.2 Bus Alternatives

The bus alternatives presented in Section 3.4 would improve travel options for a variety of commuter markets in and around the study area, offering the potential to attract ridership and divert automobile trips to bus service. The maximum projected ridership on the bus alternatives individually is relatively small: approximately 57 on Bus Alternative 1, 35 on Bus Alternative 2, and 75 on Bus Alternative 3. However, the infrastructure and equipment requirements associated with these alternatives, and their corresponding capital costs, are relatively modest. Each of the proposed bus alternatives builds on an existing or planned service, and would improve the viability of these services by reducing headways, increasing collection points, or improving the distribution of riders to key destinations. The park-and-ride facilities proposed as part of the bus alternatives can also serve drivers who wish to form carpools and vanpools,

further reducing congestion on the Spaulding Turnpike. As noted previously, the three bus alternatives include some common elements, such as park-and-ride facilities; therefore the total cost of a combined package of bus improvements is less than the total cost of the three separate alternatives. For these reasons, it is recommended that the three bus improvements be advanced for further study as a single, combined alternative in the DEIS.

3.8.3 Rail and Bus Cost Summary

Table 3.8-1 summarizes the estimated capital costs of the conceptual rail and bus alternatives that were presented in Sections 3.3 and 3.4. As noted previously, the capital cost of implementing all three bus alternatives as a single package is less than their combined costs. The capital cost of a combined Bus Alternatives package is approximately $10.6 million.

Table 3.8-1
Summary of Capital Costs of Rail and Bus Alternatives

Item	Capital Cost
Rail Alternative 1A (without second track, with DMU equipment)	$9.9 million
Rail Alternative 1A (with second track Dover to MA-NH state line, with DMU equipment)	$105.1 million
Rail Alternative 1B (without second track, with DMU equipment)	$10.3 million
Rail Alternative 1B (with second track Dover to MA-NH state line, with DMU equipment	$105.5 million
Rail Alternative 2A (Commuter Rail)	$134.0 million
Rail Alternative 2B (Commuter Rail)	$157.1 million
Rail Alternative 2B (Bus Rapid Transit)	$176.4 million
Rail Alternative 3 (total of NHDOT Phases 1-3, Rail Alt. 3 improvements)	$38.2 million
Rail Alternative 4[2]	$1.7 - $7.7 million
Bus Alternative 1[3]	$6.9 million
Bus Alternative 2[3]	$4.2 million
Bus Alternative 3[3]	$6.4 million

Notes: [1] Capital costs do not include the cost of land acquisition.
[2] Cost estimate for Rail Alternative 4 in includes both rail and roadway costs; for further information, see Section 3.3.
[3] Cost estimates for Bus Alternatives 1, 2, and 3 include the cost of park-and-ride facilities.

4

Development of Bridge and Highway Infrastructure

4.1 Introduction

This chapter describes bridge and highway alternatives developed for the Newington-Dover study area. These alternatives include the No-Build condition as a base comparison, TSM options to accommodate interim improvements at selected locations, and various bridge and highway widening alternatives from the existing two lanes in each direction to either three or four lanes in each direction. Possible design improvements to existing interchange configurations and connecting roads within the study area will also be discussed. The criteria used for developing existing and future traffic volumes are also presented in the following sections.

4.2 Traffic Criteria

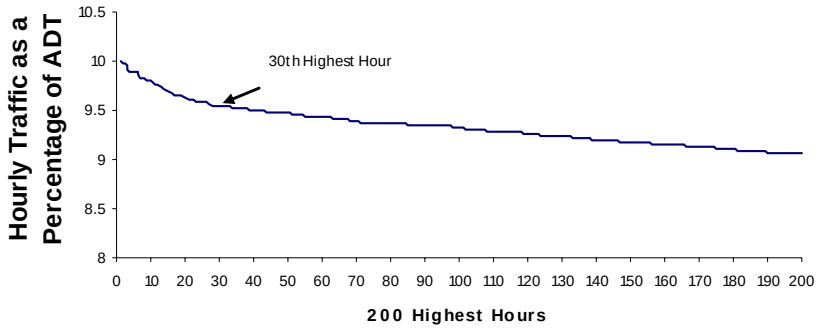
The first step in evaluating previously described alternatives is to establish an appropriate traffic volume condition. The volume of traffic along the Turnpike varies widely depending on the hour of the day, the day of the week, and the week of the year. Establishing an appropriate design volume condition is critical to the evaluation process. The purpose of this section is to present the traffic evaluation criteria that were used to assess the alternatives. The following includes a discussion on Design Hour Volume, Level of Service, and Basic Lane Requirements.

4.2.1 Design Hour Volume

The unit of measure used to evaluate and design roadway facilities is an hourly traffic volume or vehicles per hour (vph). However, because hourly traffic volumes can vary over the course of the day and throughout the year, it is necessary to select an appropriate design hourly volume condition. The hourly traffic volume used for the purpose of design should not be exceeded very often or by very much. On the other hand, it should not be so high that the volume of traffic would rarely be high enough to make full use of the facility. It would be wasteful to design an improvement based on the maximum peak hour traffic of the year, yet the use of the average hourly traffic would result in an inadequate design.

The procedure used to evaluate traffic volume demands on a roadway system, as described in *A Policy on Geometric Design of Highways and Streets*[12], is to establish a 30th highest hour volume (design condition). Given the economic considerations involved in the planning and design of roadway facilities, this design criteria is selected since the 30th highest hourly volume generally reflects a "point of diminishing return" in that a substantial increase in design requirements would accommodate only very few periods of higher traffic volumes. This condition is reflected in the curve shown in **Figure 4.2-1**, which tends to steepen quickly to the left of the 30th highest hour, indicating much higher traffic volumes for the inclusion of only a few more of the higher hourly volumes while the curve flattens to the right indicating many hours in which the volume is not much lower than the 30th highest hour.

Figure 4.2-1
Peak Hour to Average Daily Traffic Relationship
Spaulding Turnpike at Little Bay Bridges in Newington
(2003)



Based on the data collected at the NHDOT permanent count station located adjacent to the Little Bay Bridges in Newington, the 30th highest hour volume is approximately 9.55 percent of the average daily traffic (ADT). The Directional Design Hour Volume (DDHV) split shows approximately 62 percent of the total hourly traffic traveling in the peak direction (*i.e.* southbound in the weekday morning peak hour and northbound in the weekday evening peak hour).

4.2.2 Level of Service

Level of service (LOS) is a qualitative measure used to describe the operational conditions within a traffic stream and the perception of the quality of traffic flow by a motorist or passenger. Level of service generally describes these conditions in terms

[12] American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, Washington, D.C.

of such factors as speed and travel time, density or freedom to maneuver, traffic interruptions, comfort and convenience, and, in so doing, provides an index to the quality of traffic flow. Six levels of service are defined ranging in letter designation from LOS A to LOS F, with LOS A representing the best operating condition and LOS F representing the worst. LOS C describes a stable flow condition and is considered desirable for peak or design hour traffic flow. LOS D is generally considered satisfactory where the cost and/or impacts of making improvements to provide LOS C are deemed unjustified. LOS E represents capacity. Factors affecting basic capacity include the number of lanes, lateral clearance, percentage of commercial vehicles in the traffic stream, the density or spacing of interchange locations and the distribution of traffic within the peak hour. Within interchange areas, capacity is influenced by the presence and design of auxiliary lanes to facilitate the weaving of traffic across lanes and the deceleration and acceleration of vehicles, respectively, as they exit and enter the Turnpike. The traffic performance measures and the evaluation criteria used in the operational analyses are based on the methodology presented in the *2000 Highway Capacity Manual* [13](HCM).

For the purpose of the design of new roadway facilities, the NHDOT has established LOS C as desirable and LOS D as minimally acceptable. However, despite establishing LOS D as the minimally acceptable level of service, the NHDOT has also expressed a general policy of not constructing highways with more than eight basic lanes (four lanes in each direction). Therefore, for the purpose of this evaluation, the goal is to provide at least LOS D operation in the year 2025 while constructing no more than four basic lanes in each direction.

4.2.3 Basic Lane Criteria

The basic lanes of a highway are the travel lanes along a facility that are needed solely to accommodate the movement of through traffic. Basic travel lanes do not include traffic management lanes such as climbing, acceleration/deceleration, weaving, merging and auxiliary lanes, which may be needed in the vicinity of an interchange to accommodate vehicles entering and exiting the highway. These basic lanes serve to provide a consistent number of lanes over an extended length of highway.

To determine the number of basic lanes that will be needed to accommodate traffic flow along each segment of the Spaulding Turnpike within the project area, the HCM level of service criteria was applied to the future year design hour traffic volumes. Each segment of the Turnpike was evaluated to determine the basic lanes that would be needed to provide at least a LOS D operation during the design year (30th highest hourly volume) in the year 2025.

[13] 2000 Highway Capacity Manual, Transportation Research Board, Washington, D.C.

The Seacoast Regional Travel Demand Model is projecting traffic volume growth rates for the Turnpike between 0.85 and 1.35 percent per year from 2003 to 2025. By comparison, as presented in the previously published Scoping Report (March 2004), average daily traffic volumes along the corridor for the most recent 24-year period (1979 to 2003) have been growing at an average annual rate of approximately 3.7 percent. However, more recently, the average annual rate of traffic growth has declined. During the 1993 to 2003 ten-year period, traffic increased annually at an average growth rate of approximately 2.9 percent. Since 1998, traffic has increased at an average annual rate of approximately 2.1 percent per year. Future traffic volume growth rates reflect updated (2004) projections of changes in land use developed by regional planning staff[14] in concert with municipal planning officials throughout the seacoast region. These lower growth rates are consistent with developing areas as they become more urbanized.

The 2003 and projected 2025 AADT, DHV, and – most importantly for determining the number of lanes required – DDHV for each segment of the Turnpike are shown in Table 4.2-1. The projected 2025 DDHV's range from a low of 3,000 vph north of Exit 6 to a high of 5,600 vph between Exits 4 and 6.

Table 4.2-1
2025 Average Weekday and Design Hour Volumes (No-Build)

	2003			2025		
Turnpike Segment	AADT[1]	DHV[2]	DDHV[3]	AADT[1]	DHV[2]	DDHV[3]
Between Exits 1 and 2	54,700	5,200	3,200	65,900	6,300	3,900
Between Exits 2 and 3	52,900	5,100	3,200	64,700	6,200	3,800
Between Exits 3 and 4	69,300	6,600	4,100	88,000	8,400	5,200
Between Exits 4 and 5 (Little Bay Bridges)	70,650	6,700	4,200	94,300	9,000	5,600
Between Exits 5 and 6	71,050	6,800	4,200	94,600	9,000	5,600
North of Exit 6	39,850	3,800	2,400	51,600	4,900	3,000

Note: Volumes are different than those published in the Scoping Report as a result of updates made to the traffic model subsequent to March 2004.
[1] AADT - Average Annual Daily Traffic expressed in vehicles per day.
[2] DHV - Design Hour Volume expressed in vehicles per hour.
[3] DDHV - Directional Design Hour Volume expressed in vehicles per hour.

The results of the freeway segment analyses indicate that, in order to provide a LOS D operation in the future year 2025, the following number of lanes would be required along the Turnpike:

- 8 lanes (4 lanes in each direction) between Exits 3 and 6,
- 6 lanes (3 lanes in each direction) between Exits 1 and 3, and
- 4 lanes (2 lanes in each direction) north of Exit 6.

[14] Rockingham Planning Commission and Strafford Regional Planning Commission.

As stated previously, the above noted basic lane requirements are the number of travel lanes, exclusive of traffic management lanes, that are needed to accommodate through traffic along each segment of the Turnpike for the 2025 No-Build condition. It is important to note that these basic lane requirements were determined prior to considering any potential reduction in the volume of traffic that would occur as a result of the implementation of travel demand management such as rail, transit, and high occupancy vehicle (HOV) lanes and employer based programs. An evaluation of these other modes of transportation and changes in travel characteristics, and their effect on the Turnpike lane requirements, is provided in Chapter 3. (Tables 3.7-1 to 3.7-4)

In addition, it is important to recognize that the 2025 design hour volumes for the No-Build condition represent the volume of traffic during a one hour period without taking into account the peak spreading that currently occurs. As previously described in Section 2.2.1, the peak travel demand on the Turnpike actually exceeds a one hour period resulting in more hours of congestion or "peak spreading". Under the 2025 Build scenarios, it is anticipated that the Turnpike will experience an inflow of volume from the hour before and the hour after the design hour as the capacity of the highway is increased with additional travel lanes. Therefore, it is anticipated that the design hour volumes on the Turnpike will be higher under the Build scenarios than under the No-Build.

It is also anticipated that 2025 design hour volumes on the Turnpike will increase as additional lanes are provided as a result of "trip diversion". Under the existing condition, some motorists choose to travel alternative routes to avoid the congestion on the Turnpike. The alternative routes include Maine Route 236, NH Route 108, and NH Route 125. The number of motorists diverting to these alternative routes will continue to grow as congestion increases on the Turnpike under the No-Build condition, as indicated by the regional traffic model. However, with additional capacity available on the Turnpike under the Build scenario, motorists will choose to travel via the highway, reducing travel demand on alternative routes.

4.3 No-Build

The No-Build Alternative is essentially the continuation and perpetuation of the existing situation and the shortcomings inherent on the present highway and bridge corridor. The No-Build Alternative will serve as a baseline condition for comparison to other alternatives. This section also includes a discussion of the Seacoast Regional Travel Demand Model which was used to develop the future traffic volume projections.

4.3.1 Traffic Model

The Seacoast Regional Travel Demand Model is an integrated set of travel demand and land use models that helps predict travel behavior (*i.e.*, how people travel by car, bus, *etc.*) and travel demand (*i.e.*, how many people want to travel on a certain road or by a certain mode) within the Seacoast Metropolitan Planning Organization (MPO) region. In 2003, the Seacoast MPO undertook the task of updating the Model to include and reflect the latest census data, traffic volume counts, and travel demand behaviors within the region. System-wide data on roadways, bus services, rail systems, land use, and social and economic characteristics within the region were collected to update the existing base model condition. In addition, the New Hampshire Seacoast Travel Survey conducted in June 2003 provided an up-to-date source of information on existing passenger vehicle and transit ridership characteristics within the Newington-Dover project study area.

The Model was calibrated to represent the year 2000 weekday morning and weekday evening commuter peak hour conditions. Calibration of a travel demand model is considered complete when the computer-generated volumes reasonably represent actual ground counts. Calibration standards[15] published by the Federal Highway Administration (FHWA) provide guidance in determining if a model is within acceptable limits of error. Ground counts from approximately 6 percent of the roadway links in the Model (339 counts out of 5,883 one-way links) were used in the calibration process. Upon review of the 2000 Model results, both the weekday morning and evening peak hour model volumes were found to meet or exceed the FHWA guidelines. Therefore, it was determined that the 2000 Model accurately reflected the actual traffic volume conditions within the study area and could be used for planning and forecasting purposes.

The 2000 calibrated Model was then used to develop traffic forecasts for the years 2005 and 2025. The 2005 traffic projections were used to assess short term, low-cost transportation system management (TSM) alternatives to improve traffic operations efficiency and increase safety. The 2025 traffic projections were used to evaluate potential new or improved transportation services and strategies within the study area.

Future growth forecasts and land use assumptions (including housing, employment, and population) for the 2005 and 2025 scenarios were developed by the Seacoast MPO. In addition, the Model's future year highway network was modified to include planned transportation improvements that are included in the state's most recent Ten Year Transportation Plan and expected to occur by 2005 and 2025 respectively. A sample of these improvement projects within the MPO region include the Spaulding Turnpike Exit 4 Interim Safety Improvements, Spaulding Turnpike construction of

[15] **Calibration and Adjustment of System Models**, Federal Highway Administration, December 1990.

Exit 10 and easterly connection, the Exit 11 to Exit 16 Spaulding Turnpike improvements in Rochester and the US Route 1 Bypass reconstruction in Portsmouth.

4.4 Highway and Bridge Alternatives

4.4.1 Description of Highway and Bridge Segments

To allow a straightforward comparison of the various highway and bridge alternatives and options, the study area was divided into three basic segments beginning in the vicinity of the Exit 1 (Gosling Road) Interchange and extending northerly along the Spaulding Turnpike approximately 3.5 miles to just south of the Dover Toll Plaza. (The toll plaza is not included as part of the corridor evaluation.) The segments are identified as the Newington Segment, the Bridge Segment, and the Dover Segment (see **Figure 4.4-1**) and include possible interchange improvement alternatives as well as mainline widening options for the Spaulding Turnpike.

The Newington Segment involves a section of the study corridor approximately 1.7 miles in length and begins just north of the Exit 1 Interchange at Gosling Road and includes the Exit 2 Interchange with Fox Run Road, the Exit 3 Interchange with Woodbury Avenue and the Exit 4 Interchange ramps that connect to Nimble Hill Road and River Road. Immediately north of the Newington Segment is the Bridge Segment of the study corridor which is approximately 0.9 of a mile in length beginning near the Exit 4 Interchange area in Newington and ending adjacent to the Exit 5 Hilton Park Interchange area in Dover.

The Bridge Segment involves a 0.3-mile bridge section that includes the area around the existing Little Bay and General Sullivan Bridges, a 0.2-mile bridge approach section of the Spaulding Turnpike corridor in Newington, and a 0.4-mile bridge approach section of the Spaulding Turnpike corridor in Dover.

The Dover Segment begins immediately north of the Bridge Segment and is approximately 0.9 of a mile in length. This Segment extends north from the Exit 5 Interchange to just south of the Dover Toll Plaza and includes the connections to Hilton Park, Boston Harbor Road, US 4, Dover Point Road and the Exit 6 Interchange.

Highway Segment Alternatives

In developing an initial range of highway alternatives within the Newington and Dover Segments, the NHDOT's project team with input from the City of Dover, Town

of Newington and the Advisory Task Force (ATF)[16] decided first to re-examine the nine long-range conceptual interchange alternatives that were developed as part of the Spaulding Turnpike Improvements Feasibility Study (Newington-Dover, 11238) completed by the NHDOT in 2000. (The study also identified short-term "interim" safety improvements in the Exit 4 Interchange area in Newington, which are currently in the final design stage and scheduled to be constructed in 2005.) After re-examining the merits of the nine long-term alternatives (seven interchange alternatives in Newington and two interchange alternatives in Dover) with input from the ATF, along with each community's officials and residents, it was decided that for Newington, Alternatives 1 thru 5 should be eliminated from further study and Alternatives 6 and 7 should be carried forward into the EIS process. The stakeholders noted that, on the whole, Alternatives 1 thru 5 were not consistent with the Town of Newington's transportation goals while many of the elements included within Alternatives 6 and 7 better represented the community's overall transportation needs, such as improved local connectivity and safer access to the commercial/industrial land and residential properties adjacent to the corridor. For Alternatives 1 and 2 in Dover, the stakeholders felt both interchange alternatives had identified potential operational and safety improvements that warranted additional consideration and should be carried forward for further evaluation as part of the EIS process.

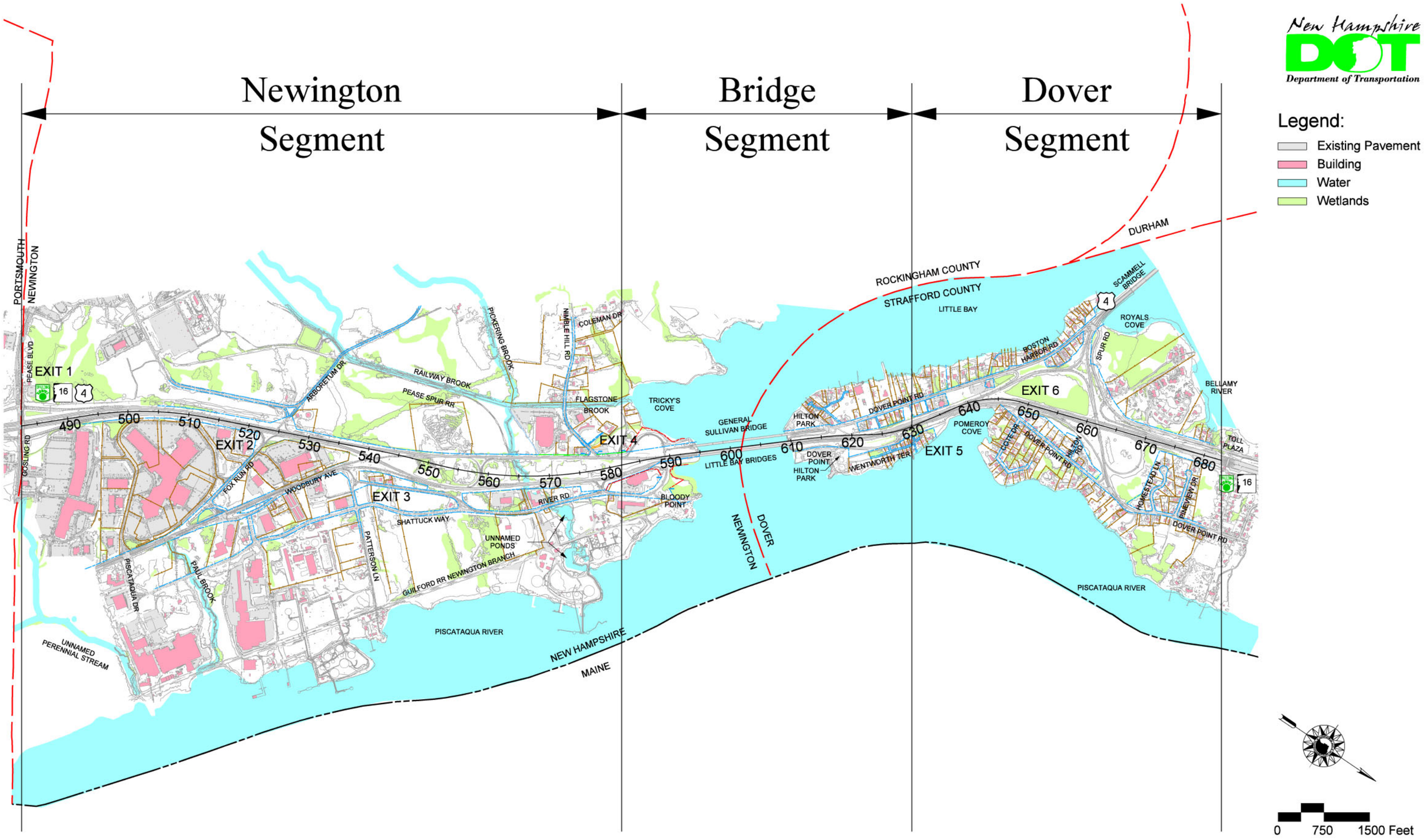
In addition to retaining four of the original Feasibility Study interchange alternatives in Newington (Alt. 6 and 7) and Dover (Alt. 1 and 2), five new interchange alternatives (Alt. 8 thru Alt.12) in Newington and one new interchange alternative in Dover (Alt. 3) were developed in concert with members of the ATF and other project stakeholders. These nine alternatives are described in more detail in the following sections of this document.

In addition to re-examining the interchange alternatives identified in the Feasibility Study, the ATF and the project team concluded that both a 6-lane and 8-lane widening of the mainline Turnpike and Little Bay Bridges should be assessed from a traffic and safety perspective and environmental impact.

Bridge Segment Alternatives

All of the Spaulding Turnpike Bridge Segment alternatives include a range of bridge options for spanning Little Bay and associated improvements to the Spaulding Turnpike approaches while linking the Newington and Dover Segments to the south

[16] The Advisory Task Force (ATF) is comprised of two representatives of each of the municipalities of Dover and Newington; single representatives of the municipalities of Durham and Portsmouth; and single representatives of the Rockingham Planning Commission (RPC), the Strafford Regional Planning Commission (SRPC), the Pease Development Authority (PDA), Cooperative Alliance for Seacoast Transportation (COAST), the Greater Dover Chamber of Commerce, the Portsmouth Chamber of Commerce, the Great Bay Estuarine Research Reserve, the Federal Highway Administration (FHWA), and the Department of Transportation (NHDOT). The ATF is a forum for providing input to the study team, and provides a conduit for the distribution of study information to representative constituencies. The ATF reviews and comments on study materials, and provides advice and guidance in the development of the project. The ATF is expected to meet approximately every three months during the course of the study, in the evenings, with meeting locations rotated between Dover and Newington.



Vanasse Hangen Brustlin, Inc.

Figure 4.4-1
Segment Breakout Map

and to the north, respectively. For the Bridge Segment, the proposed improvements for the Little Bay Bridges involve two basic categories:

- Rehabilitating and widening the existing bridges, or
- Replacing the existing structures.

Both of these categories would also include a corresponding widening and possible shift of the roadway approaches extending north and south of the existing bridge crossings depending upon which bridge option is being evaluated. The combination of the bridge improvement and the corresponding approach roadway for that bridge improvement results in a 0.2-mile section of the Spaulding Turnpike corridor in Newington and a 0.4-mile section of the Spaulding Turnpike corridor in Dover being included as part of the Bridge Segment alternatives evaluation. This provides for a more consistent comparison of impacts and costs associated with crossing the Piscataqua River and Little Bay Channel.

In addition, as a result of input from project stakeholders, the two basic categories, widening and replacement, will include options that incorporate a multi-use pathway that allows pedestrians and bicyclists to cross over the Piscataqua River between Newington and Dover. Today the General Sullivan Bridge, which was closed to vehicular traffic in 1984**,** provides this connection.

The first category includes three widening options that retain and rehabilitate the existing 4-lane Little Bay Bridges and then widen the Little Bay Bridges, in-kind, either all to the east (holding the westerly edge of the existing Little Bay Bridges and widening all to the east), all to the west (holding the easterly edge of the existing Little Bay Bridges and widening all to the west) or widening equally on both sides (holding the existing centerline of the Little Bay Bridges and widening the same amount to the east and to the west) to provide for the additional highway lanes. Each of these three widening options, as noted previously, would also include a corresponding widening and realignment of the Spaulding Turnpike highway approaches for both the Newington and Dover Segments. The multi-use pathway is then integrated into each of these widening options either by rehabilitating the existing General Sullivan Bridge for use as a new pathway and/or facility for local traffic or transit vehicles only, or by removing the General Sullivan Bridge and adding additional width (for the pedestrian and bicyclist pathway) to the Little Bay Bridges on the westerly side of any of the three widening options, creating a total of six widening options. Options that widen the Little Bay Bridges address the current deficiency of substandard shoulder width, and retain the existing profile (60 MPH design speed). These alternatives are described in more detail in the following sections.

The second category, replacement, involves the complete replacement of the Little Bay Bridges, either on-line (constructing a new replacement bridge on the existing centerline-alignment of the Little Bay Bridges) or off-line (constructing a new replacement bridge on a new centerline-alignment west of the existing Little Bay Bridges) to accommodate six or eight lanes as well as a multi-use path. The on-line

variations involve the same six basic options noted above for the Little Bay Bridges widening category; however, instead of rehabilitation and widening of the existing Little Bay Bridges, the existing bridges would be completely removed and replaced with a new wider bridge. As with the widening/rehabilitation category options, a multi-use path would be provided via either the rehabilitation of the General Sullivan Bridge or the removal of the General Sullivan Bridge and the additional widening of the new Little Bay Bridge. The off-line variations include shifting the new centerline west of the Little Bay Bridges approximately 130 feet and constructing a new bridge that would accommodate six or eight lanes as well as the multi-use path. Two bridge types were considered for this variation; the first is a Concrete Arch Bridge and the second is a Cable-Stayed Bridge. All replacement options would improve the profile increasing the stopping sight distance from 60 MPH to 70 MPH. The increase in sight distance would be accomplished by flattening the vertical curve over the bridge, which would require the abutments to be raised approximately 5 feet higher than existing. This would result in an overall bridge and roadway approach footprint that is somewhat wider due to the profile grade raise and the associated roadway embankment.

The replacement category also involves eight replacement options- six on-line and two off-line options. All eight options would also include a corresponding widening and realignment of the Spaulding Turnpike highway approaches for both the Newington and Dover Segments.

The rehabilitation/widening and replacement options noted above are described in more detail in the following sections.

Additionally, in developing the range of alternatives in conjunction with the ATF, the following options were studied conceptually but were not advanced beyond the conceptual phase.

These options include:

- **Double Decker Bridge Option** - This option would modify and utilize the existing Little Bay Bridges to carry three or four lanes of traffic in the northbound direction and construct a new 4-lane upper level bridge deck, over the existing bridges, to carry the southbound traffic. The intent of this Double Decker Bridge option was to try and minimize property impacts at the Dover end of the structure by reducing the overall widening footprint. This option was presented at the ATF meeting on April 28, 2004. The option resulted in no substantial reduction of property impacts; however, the option did result in higher construction costs than options with similar impacts, and created issues with traffic control and maintenance of traffic during construction due to the need to restrict traffic on the existing structure during the placement of the girders and deck of the upper level. This option was recommended to not be studied further.

- **Tunnel Option** - This option would construct a new 6- or 8-lane tunnel to carry northbound and southbound traffic under Little Bay. This option was not formally developed, but was evaluated conceptually. It was not carried forward due to its high costs which were in the range of $400M, and also the difficulty associated with its construction and maintenance.

- **Utilizing the General Sullivan Bridge to carry peak hour traffic** - The ATF asked that an option be considered that would utilize the existing General Sullivan Bridge to carry two lanes of peak hour traffic southbound in the morning and northbound in the evening. This option was not formally developed, but was evaluated conceptually. It was not carried forward due to the limiting vertical geometry of the General Sullivan Bridge that limits driver sight distance (45 MPH) and the existing narrow width of the structure (two 12-foot lanes with 2-foot shoulders). Using the bridge for Turnpike vehicular traffic would also require the exclusion of pedestrians and bicyclists.

4.4.2 Highway Segment Alternatives with Interchange Options

Spaulding Turnpike Mainline

The Spaulding Turnpike mainline reconstruction comprises two basic options that involve a combination of widening and realigning the Spaulding Turnpike over the 3.5-mile area between Exit 1, in Newington, and the Toll Plaza, in Dover. For both options the proposed realignment and widening centerlines are essentially the same except for the area within the Bridge Segment where the Little Bay Bridge options could shift the mainline alignment westerly by as much as 130 feet. The two basic options for the Spaulding Turnpike mainline widening include:

- **6-lane Option**- A combination four lanes (from the Exit 6 to the Toll Plaza) and six lanes (from Exit 1 to Exit 6), with six lanes on the Little Bay Bridges;

- **8-lane Option**- A combination six lanes (from Exit 1 to Exit 3; and from Exit 6 to the Toll Plaza) and eight lanes (from Exit 3 to Exit 6), with eight lanes on the Little Bay Bridges;

For the 6-lane option, the proposed realignment and widening of the Spaulding Turnpike would begin by extending the existing 6-lane section northerly from Exit 1 at Gosling Road through Exit 3 at Woodbury Avenue and Exit 4 at River Road and Nimble Hill Road, across the Little Bay Bridges, and through the Exit 5 Interchange area in Dover where the six lanes would transition back to the existing 4-lane section between the Exit 6 Interchange area and the Toll Plaza.

For the 8-lane option, the proposed realignment and widening would begin by extending the existing 6-lane section on the Spaulding Turnpike northerly from Exit 1 at Gosling Road to Exit 3 at Woodbury Avenue and then transition to an 8-lane

section north of Exit 3, through Exit 4 at River Road and Nimble Hill Road, across the Little Bay Bridges, and through the Exit 5 Interchange area in Dover. The 8-lane section would then transition to a 6-lane section in the Exit 6 Interchange area and end just south of the existing eight toll lanes at the Dover Toll Plaza.

All of the interchange alternatives for the Newington and Dover Segments, as well as the bridge options for the Bridge Segment can be incorporated with either the 6-lane or the 8-lane mainline options.

Newington Segment

The 1.7-mile Newington Segment begins just north of the Exit 1 Interchange and ends approximately 0.3 of a mile south of the existing Little Bay Bridges (**Figure 4.4-1**). There are a total of seven Newington Alternatives. The major elements of this Segment involve the widening and/or realignment of the Spaulding Turnpike from the existing 6-lane section at the Exit 1 Interchange[17] to six or eight lanes; improved access to the Spaulding Turnpike from the adjacent roadways such as Woodbury Avenue, Arboretum Drive, Nimble Hill Road, and River Road; improved local connectivity with the segregation of industrial and residential related traffic; and the provision for a future Pease Spur rail corridor connection with the Newington Branch of the Guilford Railroad system.

Within this Segment, the Spaulding Turnpike mainline alignment is essentially the same for all seven alternatives. All alternatives for this Segment utilize either six lanes or a combination of six and eight mainline travel lanes, except where additional traffic management lanes may be necessary to accommodate traffic entering/merging and/or diverging/exiting at proposed interchange areas. The proposed mainline improvements for all seven alternatives begin approximately 0.2 miles north of the Exit 1 (Gosling Road) Interchange. The alignment in this area will primarily consist of a westerly widening of the existing four travel lanes through the Exit 2 Interchange. All alternatives eliminate the existing Exit 2 Interchange and the existing Exit 2 ramps to Fox Run Road would be closed and a cul-de-sac provided for vehicles to reverse direction. The existing Exit 2 traffic would be re-routed northerly to a new improved interchange in the vicinity of the existing Exit 3 (Woodbury Avenue) Interchange. Between the Exit 3 Interchange with Woodbury Avenue and the Exit 4 Interchange to River Road and Nimble Hill Road, the northbound and southbound lanes would be relocated into the existing wide median area (500 feet wide). This will allow for improved geometry, flexibility in developing new interchange options and connections to adjacent local roads, and ease of construction and maintenance of traffic during construction. For all Newington Alternatives the existing Exit 4 southbound on-ramp bridge that passes over the loop ramp from River Road would be either reconstructed and widened or replaced in its existing location (impacts are evaluated as part of the Bridge Segment).

[17] The existing Spaulding Turnpike transitions from 6 lanes to 4 lanes between Exit 1 and Exit 2.

Newington Alternative 6 Revised

Based upon recommendations from the ATF and Newington officials, Alternative 6, developed in 2000 as part of the Spaulding Turnpike Improvements Feasibility Study, was carried forward for further evaluation as part of this EIS study process. The ATF requested that the original Alternative 6 concept be revised to eliminate impacts to the existing water supply storage tank adjacent to Arboretum Drive by shifting the proposed southbound loop-ramp configuration at Woodbury Avenue further to the north. The ATF also asked that the new Alternative 6 Revised (**Figure 4.4-2**) include a southbound on-ramp from Woodbury Avenue (not included with the original Alternative 6). Alternative 6 Revised involves three basic components - the development of a new full interchange at Woodbury Avenue that combines the existing Exits 2 and 3, the reconstruction of the existing Exit 4 Interchange at Nimble Hill Road and River Road, and the relocation of the currently inactive Pease Spur rail corridor to allow for future rail connectivity to the Pease Tradeport. The proposed Woodbury Avenue Interchange would be a full access interchange that would involve removing the existing Exit 3 Interchange and the reconstruction and widening of Woodbury Avenue for approximately 0.4 of a mile and the extension of Woodbury Avenue approximately 0.8 of a mile westerly over the Spaulding Turnpike to connect with Arboretum Drive and the northerly end of the Pease Tradeport. The proposed reconstruction of Woodbury Avenue would extend the two existing travel lanes in each direction and the center-turning lane/median from the Fox Run Road intersection through the new interchange area before transitioning back to one travel-lane in each direction as it approaches Arboretum Drive. The Spaulding Turnpike northbound ramps and southbound ramps would connect to Woodbury Avenue at signalized intersections in a diamond-type configuration and a loop configuration, respectively. Access to Patterson Lane from River Road would be closed and a turnaround provided at its southerly terminus. Two new connections from the proposed Woodbury Avenue extension to the bypassed section of existing Arboretum Drive would be provided.

At the Exit 4 Interchange, the existing substandard northbound and southbound ramps would be reconstructed to a more standard design geometry and connected to the Nimble Hill Road and River Road interim improvements. (The interim improvements are anticipated to be constructed in 2005.)

The inactive Pease Spur rail crossing currently located between Exit 3 and Exit 4 would be eliminated and a new crossing provided approximately 0.5 of a mile to the south. The new crossing and approaches would involve constructing approximately 1.0 mile of a new rail corridor to retain future rail connectivity into the Pease Tradeport. (At this time only the necessary grading, drainage, and rail/highway structures for the future Pease Spur would be completed.) The relocation of the Pease Spur would begin in the vicinity of Patterson Lane and the Newington Branch of the Guilford RR and extend across Shattuck Way (future at-grade rail crossing) and then traverse under the northbound Woodbury Avenue on-ramp (at the existing Exit 3) and the Spaulding Turnpike and then connect with the existing Pease Rail Spur on the westerly side of the Spaulding Turnpike.

Newington Alternative 7

Like Alternative 6 Revised described above, Newington Alternative 7 was carried forward for further evaluation (**Figure 4.4-3**). Alternative 7 essentially would replace the existing substandard Exits 2, 3, and 4 Interchanges with one full access "single-point urban interchange"(SPUI) located in the existing median area approximately midway between Exit 3 and Exit 4. This type of interchange is a variation of the more classical signalized diamond interchange that allows one traffic signal (instead of two signals) to control all crossing movements and process relatively high traffic volumes in a relatively compact footprint. The other major components of Alternative 7 involve the construction of 1.1 miles of a new road, which would connect the existing local roadways, the Pease Tradeport and the industrial area with the Spaulding Turnpike. The new Connector Road would begin at River Road on the easterly side of the Turnpike and extend through the new interchange, under the Spaulding Turnpike, and intersect the new Woodbury Avenue and Nimble Hill Road extensions before connecting to Arboretum Drive and the Pease Tradeport on the westerly side of the Turnpike. Woodbury Avenue would be reconstructed and widened northerly from Fox Run Road for 0.4 of a mile and then extended 0.4 of a mile to intersect with the Connector Road. Nimble Hill Road would be extended southerly 0.5 of a mile to the Connector Road opposite Woodbury Avenue creating a new signalized four-way intersection. In addition, two direct free-flow ramp connections would be provided between the Spaulding Turnpike and Woodbury Avenue to accommodate the heavy northbound on-ramp and southbound off-ramp traffic volumes. Access at Patterson Lane would be closed and a turnaround provided at its southerly terminus. A 0.4-mile section of Shattuck Way/River Road would be reconstructed and widened to accommodate turning traffic to the new single-point interchange, and approximately 0.3 of a mile of Arboretum Drive would be relocated to provide connections to the Tradeport. Also the existing northbound and southbound Exit 4 ramps would be discontinued.

The inactive Pease Spur rail crossing currently located between Exit 3 and Exit 4 would be eliminated and a new crossing provided approximately 0.5 of a mile to the south. The new crossing and approaches would involve constructing approximately 1.0 mile of a new rail corridor to provide future rail connectivity into the Pease Tradeport. (At this time only the necessary grading, drainage, and rail/highway structures for the future Pease Spur would be completed.) The relocation of the Pease Spur would begin in the vicinity of Patterson Lane and the Newington Branch of the Guilford RR and extend westerly across Shattuck Way (future at-grade rail crossing), under the Spaulding Turnpike, under the Woodbury Avenue extension, and then connect with the existing Pease Rail Spur on the westerly side of the Spaulding Turnpike.

Newington Alternative 8

Alternative 8 was a variation of the SPUI interchange configuration developed for Alternative 7. All other improvement elements for both Alternative 7 and 8 would remain identical. Alternative 8 would substitute a "tight diamond" interchange for the

New Hampshire DOT
Department of Transportation

PORTSMOUTH
NEWINGTON

PEASE BLVD
GOSLING RD
EXIT 1
SPAULDING TURNPIKE
16
4
490
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520
530
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560
570
580
590
ARBORETUM DR
RAILWAY BROOK
PEASE SPUR RR
PICKERING BROOK
NIMBLE HILL RD
COLEMAN DR
FLAGSTONE BROOK
TRICKY'S COVE
EXIT 2
EXIT 3
EXIT 4
FOX RUN RD
WOODBURY AVE
RIVER RD
BLOODY POINT
SHATTUCK WAY
PATTERSON LN
PISCATAQUA DR
PAUL BROOK
GUILFORD RR NEWINGTON BRANCH
Newington Segments
Bridge Segments
PISCATAQUA RIVER
NEW HAMPSHIRE
MAINE

Legend:

- Existing Pavement
- Building
- Water
- Wetlands
- Conceptual Roadway Improvements
- Proposed Bridge
- 1 or 2 Lane Conceptual Roadway
- Proposed Signal
- 3/4 Proposed Roadway Lanes
- Existing ROW
- Existing Property Lines
- Newington Interim Improvements
- Relocated Rail Spur

0 400 800 Feet

Vanasse Hangen Brustlin, Inc.

Figure 4.4-2
Newington Alternative 6 Revised

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New Hampshire DOT
Department of Transportation

PORTSMOUTH
NEWINGTON

EXIT 1
EXIT 2
EXIT 3
EXIT 4

PEASE BLVD
GOSLING RD
ARBORETUM DR
RAILWAY BROOK
PEASE SPUR RR
PICKERING BROOK
NIMBLE HILL RD
COLEMAN DR
FLAGSTONE BROOK
TRICKY'S COVE
FOX RUN RD
WOODBURY AVE
SHATTUCK WAY
RIVER RD
BLOODY POINT
PATTERSON LN
PISCATAQUA DR
PAUL BROOK
GUILFORD RR NEWINGTON BRANCH
PISCATAQUA RIVER
NEW HAMPSHIRE
MAINE

Newington Segments
Bridge Segments

0 400 800 Feet

Legend:

- Existing Pavement
- Building
- Water
- Wetlands
- Conceptual Roadway Improvements
- Proposed Bridge
- 1 or 2 Lane Conceptual Roadway
- Proposed Signal
- 3/4 Proposed Roadway Lanes
- Existing ROW
- Existing Property Lines
- Newington Interim Improvements
- Relocated Rail Spur

Vanasse Hangen Brustlin, Inc.

Figure 4.4-3
Newington Alternative 7

SPUI of Alternative 7. This "tight diamond" design was considered because diamond-type interchanges, for locations such as this, are generally less costly than a SPUI configuration due to the reduction in roadway embankment height and structure costs. The diamond interchange for Alternative 8 would have one signal at each of the southbound and northbound ramps terminals where the SPUI would use only one signal. Alternative 8 failed from a traffic operations perspective and was not brought forward for public discussion.

Newington Alternative 9

Alternative 9 (**Figure 4.4-4**) would involve three basic components - the replacement of the existing substandard Exits 2, 3, and 4 Interchanges with one full-access, combination diamond, and partial cloverleaf interchange located at Woodbury Avenue, the development of a new Connector Road linking River Road on the east side of the Turnpike with Arboretum Drive and the Pease Tradeport on the west side, and the grade-separation of the existing and currently inactive Pease Spur rail corridor to allow for future rail connectivity to the Tradeport.

The Woodbury Avenue reconstruction would extend the two existing travel lanes in each direction and the center-turning lane/median from the Fox Run Road intersection westerly in close proximity to the Turnpike mainline approximately 0.7 of a mile through the new interchange area before transitioning back to one travel lane in each direction and intersecting with a new Connector Road that would link River Road, Arboretum Drive and Nimble Hill Road. The Spaulding Turnpike northbound ramps and southbound ramps would connect to Woodbury Avenue at signalized intersections in a diamond-type configuration and a loop configuration, respectively. The new Connector Road would begin at River Road on the easterly side of the Turnpike and extend for 1.1 miles passing under the Spaulding Turnpike, adjacent to the new Pease Spur rail right-of-way, and intersect at a new signalized four-way intersection with the extension of Woodbury Avenue and the 0.5-mile extension of Nimble Hill Road before connecting to Arboretum Drive and the Pease Tradeport on the westerly side of the Turnpike. Access between Patterson Lane and Woodbury Avenue would be closed. A 0.2-mile section of Shattuck Way/River Road would be reconstructed and widened to accommodate turning traffic to the Connector Road, and approximately 0.2 of a mile of Arboretum Drive would be relocated to provide connections to the Connector Road.

The inactive Pease Spur RR grade crossing currently located between Exit 3 and Exit 4 would be retained for future connectivity into the Tradeport by raising the existing grade of the Spaulding Turnpike approximately 25 feet to pass over the rail spur and the adjacent Connector Road.

An option for retaining the southbound off-ramp at Exit 4 was developed to assess the benefits and potential impacts of a more direct southbound connection to Nimble Hill Road. Because of the close proximity of the existing private driveways on Nimble Hill Road to the southbound off-ramp layout creating potential safety and operational

problems, a 0.1-mile section of Nimble Hill Road would need to be relocated behind the existing Exxon service station as part of the Nimble Hill Road extension south to the new Connector Road. (Retaining the Exit 4 southbound on-ramp in conjunction with the southbound off-ramp was not considered because of the poor traffic operations (weaving) that would result due to vehicles entering and exiting the Turnpike between the proposed Exit 3 (Woodbury Avenue) southbound off-ramp and the Exit 4 southbound on-ramp.)

Newington Alternative 10

Alternative 10 (**Figure 4.4-5**) involves four basic components - the replacement of the existing substandard Exits 2, 3, and 4 Interchanges with one full-access diamond interchange located at Woodbury Avenue, the reconstruction of the existing northbound ramps at the Exit 4 Interchange at River Road, the development of a new Connector Road linking River Road on the east side of the Turnpike with Arboretum Drive and the Pease Tradeport on the west side, and the grade-separation of the existing and currently inactive Pease Spur rail corridor to allow for future rail connectivity to the Tradeport.

The proposed Woodbury Avenue Interchange would be a full access interchange that would involve removing the existing Exit 3 Interchange and the reconstruction and widening of Woodbury Avenue for approximately 0.4 of a mile and extending Woodbury Avenue approximately 0.3 of a mile westerly over the Spaulding Turnpike to intersect with a new Connector Road that would link the northerly end of the Tradeport with River Road and Nimble Hill Road. The proposed reconstruction of Woodbury Avenue would extend the two existing travel lanes in each direction and the center-turning lane/median from the Fox Run Road intersection through the new interchange area before transitioning to left and right-turning lanes westbound, and two travel lanes eastbound. The Woodbury Avenue and Connector Road intersection would be signalized. The Spaulding Turnpike northbound ramps and southbound ramps would connect to Woodbury Avenue at signalized intersections in a diamond-type configuration.

The new Connector Road would begin at River Road on the easterly side of the Turnpike and extend for 1.1 miles passing under the Spaulding Turnpike, adjacent to the Pease Spur rail right-of-way, and intersecting at a three-way intersection with the 0.5-mile extension of Nimble Hill Road before connecting to Arboretum Drive and the Pease Tradeport on the westerly side of the Turnpike. Access between Patterson Lane and Woodbury Avenue would be closed. A 0.2-mile section of Shattuck Way/River Road would be reconstructed and widened to accommodate turning traffic to the Connector Road, and approximately 0.2 of a mile of Arboretum Drive would be relocated to provide connections to the Connector Road.

At the existing Exit 4 Interchange, interim improvements (scheduled to be constructed in 2005) to River Road and the northbound ramps will be utilized to the greatest extent practicable, so as to minimize additional impacts to this area, if any.

PORTSMOUTH
NEWINGTON

PEASE BLVD

EXIT 1

16

4

GOSLING RD

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580

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EXIT 2

EXIT 3

EXIT 4

ARBORETUM DR

RAILWAY BROOK

PEASE SPUR RR

PICKERING BROOK

NIMBLE HILL RD

COLEMAN DR

FLAGSTONE

BROOK

TRICKY'S
COVE

POSSIBLE
LOCAL
CONNECTION

POSSIBLE
SB OFF
RAMP

FOX RUN RD

WOODBURY AVE

RIVER RD

BLOODY
POINT

SHATTUCK WAY

PATTERSON LN

PAUL BROOK

PISCATAQUA DR

GUILFORD RR NEWINGTON BRANCH

Newington
Segments

Bridge
Segments

PISCATAQUA RIVER

NEW HAMPSHIRE

MAINE

New Hampshire
DOT
Department of Transportation

Legend:

- Existing Pavement
- Building
- Water
- Wetlands
- Conceptual Roadway Improvements
- Proposed Bridge
- 1 or 2 Lane Conceptual Roadway
- Proposed Signal
- 3/4 Proposed Roadway Lanes
- Existing ROW
- Existing Property Lines
- Newington Interim Improvements
- Relocated Rail Spur

0 400 800 Feet

Vanasse Hangen Brustlin, Inc.

Figure 4.4-4
Newington Alternative 9

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New Hampshire DOT
Department of Transportation

PORTSMOUTH
NEWINGTON

PEASE BLVD
GOSLING RD
EXIT 1
SPAULDING TURNPIKE
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EXIT 2
EXIT 3
EXIT 4
ARBORETUM DR
RAILWAY BROOK
PEASE SPUR RR
PICKERING BROOK
NIMBLE HILL RD
COLEMAN DR
FLAGSTONE
BROOK
TRICKY'S
COVE
POSSIBLE
LOCAL
CONNECTION
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SB OFF
RAMP
FOX RUN RD
WOODBURY AVE
SHATTUCK WAY
PATTERSON LN
RIVER RD
BLOODY
POINT
PISCATAQUA DR
PAUL BROOK
GUILFORD RR NEWINGTON BRANCH
Newington
Segments
Bridge
Segments
PISCATAQUA RIVER
NEW HAMPSHIRE
MAINE

Legend:
- Existing Pavement
- Building
- Water
- Wetlands
- Conceptual Roadway Improvements
- Proposed Bridge
- 1 or 2 Lane Conceptual Roadway
- Proposed Signal
- 3/4 Proposed Roadway Lanes
- Existing ROW
- Existing Property Lines
- Newington Interim Improvements
- Relocated Rail Spur

0 400 800 Feet

Vanasse Hangen Brustlin, Inc.

Figure 4.4-5
Newington Alternative 10

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The inactive Pease Spur rail at-grade crossing of River Road currently located between Exit 3 and Exit 4 would be retained for future connectivity into the Tradeport by raising the existing grade of the Spaulding Turnpike approximately 25 feet to pass over the rail spur and the adjacent Connector Road.

An option for retaining the southbound off-ramp at Exit 4 was developed to assess the benefits and potential impacts of a more direct southbound connection to Nimble Hill Road. Because of the close proximity of the existing private driveways on Nimble Hill Road to the southbound off-ramp layout creating potential safety and operational problems, a 0.1-mile section of Nimble Hill Road would be relocated behind the existing Exxon service station as part of the Nimble Hill Road extension south to the new Connector Road. (Retaining the Exit 4 southbound on-ramp in conjunction with the southbound off-ramp was not considered because of the poor traffic operations (weaving) that would result due to vehicles entering and exiting the Turnpike between the proposed Exit 3 (Woodbury Avenue) southbound off-ramp and the Exit 4 southbound on-ramp.)

Newington Alternative 11

Alternative 11 (**Figure 4.4-6**) involves five basic design components - the replacement of the existing substandard Exits 2, 3, and 4 Interchanges with one full-access diamond interchange located at Woodbury Avenue, the reconstruction of the existing northbound ramps at the Exit 4 Interchange at River Road, the development of a new Connector Road that links Nimble Hill Road with Woodbury Avenue and the Pease Tradeport, the relocation and extension of Patterson Lane connecting Shattuck Way with the Exit 3 Interchange and Arboretum Drive, and the relocation of the currently inactive Pease Spur rail corridor to allow for future rail connectivity to the Pease Tradeport. The proposed Woodbury Avenue Interchange is similar to Alternative 10 and involves removing the existing Exit 3 Interchange and the reconstruction and widening of Woodbury Avenue for approximately 0.4 of a mile and the extension of Woodbury Avenue approximately 0.3 of a mile westerly over the Spaulding Turnpike to intersect with a new Connector Road that would link the northerly end of the Pease Tradeport with Nimble Hill Road. The proposed reconstruction of Woodbury Avenue would extend the two existing travel lanes in each direction and the center-turning lane/median from the Fox Run Road intersection over the extension of Patterson Lane and the relocation of the Pease Spur rail corridor and through the new interchange area before intersecting with the new Connector Road. The Woodbury Avenue and Connector Road intersection would be signalized. The Spaulding Turnpike northbound ramps and southbound ramps would connect to Woodbury Avenue at signalized intersections in a diamond-type configuration.

The proposed Connector Road would begin at Nimble Hill Road and extend southerly for 1.1 miles, adjacent to the existing inactive Pease Spur right-of-way, and intersect with Woodbury Avenue before connecting to Arboretum Drive and the Pease Tradeport. Patterson Lane would be reconstructed for approximately 0.5 of a

mile, intersecting with Shattuck Way then passing under the Turnpike, Woodbury Avenue and the southbound on-ramp before intersecting with the Connector Road opposite a 0.2-mile relocation of Arboretum Drive. Access between Patterson Lane and Woodbury Avenue would be closed.

At the existing Exit 4 Interchange, interim improvements (scheduled to be constructed in 2005) to River Road and the northbound ramps will be utilized to the greatest extent practicable, so as to minimize additional impacts to this area, if any.

The inactive Pease Spur rail at-grade crossing of River Road currently located between Exit 3 and Exit 4 would be eliminated and a new crossing provided approximately 0.5 of a mile to the south. The new crossing and approaches would involve constructing approximately 1.0 mile of a new rail corridor to retain future rail connectivity into the Pease Tradeport. (At this time only the necessary grading, drainage, and rail/highway structures for the future Pease Spur would be completed.) The relocation of the Pease Spur begins in the vicinity of Patterson Lane and the Newington Branch of the Guilford RR and extends across Shattuck Way (future at-grade rail crossing) and under Woodbury Avenue, the Spaulding Turnpike and the southbound on-ramp before connecting with the existing Pease Spur on the westerly side of the Spaulding Turnpike.

An option for retaining the southbound off-ramp at Exit 4 was developed to assess the benefits and potential impacts of a more direct southbound connection to Nimble Hill Road. In addition, and because of the close proximity of the existing private driveways on Nimble Hill Road to the southbound off-ramp layout creating potential safety and operational problems, a 0.1-mile section of Nimble Hill Road would be relocated behind the existing Exxon service station as part of the Nimble Hill Road extension south to the new Connector Road. (Retaining the Exit 4 southbound on-ramp in conjunction with a possible southbound off-ramp was not considered because of the poor traffic operations (weaving) that would result due to vehicles entering and exiting the Turnpike between the proposed Exit 3 (Woodbury Avenue) southbound off-ramp and the Exit 4 southbound on-ramp.)

Newington Alternative 12

Alternative 12 (**Figure 4.4-7**) is very similar to Alternative 11 except for the layout of southbound ramps at the proposed Woodbury Avenue Interchange and the connection of proposed improvements between Patterson Lane and the Connector Road. Alternative 12 also involves five basic design components - the replacement of the existing substandard Exits 2, 3, and 4 Interchanges with one full-access, combination diamond, and partial cloverleaf interchange located at Woodbury Avenue, the reconstruction of the existing northbound ramps at the Exit 4 Interchange at River Road, the development of a new Connector Road that would link Nimble Hill Road with Woodbury Avenue and the Tradeport, the relocation and extension of Patterson Lane connecting Shattuck Way with the Exit 3 Interchange area and Arboretum Drive, and the relocation of the currently inactive Pease Spur rail corridor to allow for future rail connectivity to the Pease Tradeport. The Spaulding Turnpike

PORTSMOUTH
NEWINGTON

PEASE BLVD

EXIT 1

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GOSLING RD

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590

EXIT 2

EXIT 3

EXIT 4

ARBORETUM DR

RAILWAY BROOK

PEASE SPUR RR

PICKERING BROOK

NIMBLE HILL RD

COLEMAN DR

FLAGSTONE
BROOK

TRICKY'S
COVE

POSSIBLE
LOCAL
CONNECTION

POSSIBLE
SB OFF
RAMP

FOX RUN RD

WOODBURY AVE

SHATTUCK WAY

PATTERSON LN

RIVER RD

BLOODY
POINT

Newington
Segments

Bridge
Segments

PISCATAQUA DR

PAUL BROOK

GUILFORD RR NEWINGTON BRANCH

PISCATAQUA RIVER

NEW HAMPSHIRE

MAINE

New Hampshire DOT
Department of Transportation

Legend:

- Existing Pavement
- Building
- Water
- Wetlands
- Conceptual Roadway Improvements
- Proposed Bridge
- 1 or 2 Lane Conceptual Roadway
- Proposed Signal
- 3/4 Proposed Roadway Lanes
- Existing ROW
- Existing Property Lines
- Newington Interim Improvements
- Relocated Rail Spur

0 400 800 Feet

Vanasse Hangen Brustlin, Inc.

Figure 4.4-6
Newington Alternative 11

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PORTSMOUTH
NEWINGTON

PEASE BLVD

EXIT 1

16

4

GOSLING RD

490

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540

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560

570

580

590

EXIT 2

FOX RUN RD

WOODBURY AVE

EXIT 3

ARBORETUM DR

RAILWAY BROOK

PEASE SPUR RR

PICKERING BROOK

NIMBLE HILL RD

COLEMAN DR

POSSIBLE LOCAL CONNECTION

FLAGSTONE BROOK

TRICKY'S COVE

POSSIBLE SB OFF RAMP

EXIT 4

RIVER RD

BLOODY POINT

SHATTUCK WAY

PATTERSON LN

GUILFORD RR NEWINGTON BRANCH

Newington Segments

Bridge Segments

PISCATAQUA DR

PAUL BROOK

PISCATAQUA RIVER

NEW HAMPSHIRE

MAINE

New Hampshire DOT
Department of Transportation

Legend:

- Existing Pavement
- Building
- Water
- Wetlands
- Conceptual Roadway Improvements
- Proposed Bridge
- 1 or 2 Lane Conceptual Roadway
- Proposed Signal
- 3/4 Proposed Roadway Lanes
- Existing ROW
- Existing Property Lines
- Newington Interim Improvements
- Relocated Rail Spur

0 400 800 Feet

Vanasse Hangen Brustlin, Inc.

Figure 4.4-7
Newington Alternative 12

northbound ramps and southbound ramps would connect to Woodbury Avenue at signalized intersections in a diamond-type configuration and a loop configuration, respectively. The proposed Woodbury Avenue Interchange would involve removing the existing Exit 3 Interchange and the reconstruction and widening of Woodbury Avenue for approximately 0.4 of a mile and the extension of Woodbury Avenue approximately 0.5 of a mile westerly over the Spaulding Turnpike intersecting with a new Connector Road before intersecting and ending at Arboretum Drive. The Woodbury Avenue reconstruction would extend the two existing travel lanes in each direction and the center-turning lane/median beginning at the signalized intersection with Fox Run Road and continuing over the extension of Patterson Lane and the new Tradeport rail corridor and through the new interchange area before intersecting with the Connector Road and then transitioning to one lane in each direction at the intersection with Arboretum Drive. A 0.2-mile section of Arboretum Drive would be widened and reconstructed.

The new Connector Road would begin at Nimble Hill Road and extend for 0.7 of a mile, adjacent to the existing inactive Pease Spur right-of-way, and intersect at Woodbury Avenue opposite the proposed extension of Patterson Lane creating a four-way signalized intersection. Patterson Lane would be reconstructed for approximately 0.5 of a mile intersecting with Shattuck Way then passing under Woodbury Avenue and the Turnpike before intersecting with Woodbury Avenue opposite the Connector Road. Access between Patterson Lane and Woodbury Avenue would be closed.

At the existing Exit 4 Interchange, interim improvements (scheduled to be constructed in 2005) to River Road and the northbound ramps will be utilized to the greatest extent practicable, so as to minimize additional impacts to this area, if any.

The inactive Pease Spur crossing currently located between Exit 3 and Exit 4 would be eliminated and a new crossing provided approximately 0.5 of a mile to the south. The new crossing and approaches would involve constructing approximately 1.0 mile of a new rail corridor to retain future rail connectivity into the Pease Tradeport. (At this time only the necessary grading, drainage, and rail/highway structures for the future Pease Spur would be completed.) The relocation of the Pease Spur would begin in the vicinity of Patterson Lane and the Newington Branch of the Guilford RR and extend across Shattuck Way (future at-grade rail crossing) and under Woodbury Avenue and the Spaulding Turnpike before connecting with the existing Pease Rail Spur on the westerly side of the Spaulding Turnpike.

An option for retaining the southbound off-ramp at Exit 4 was developed to assess the benefits and potential impacts of a more direct southbound connection to Nimble Hill Road. Because of the close proximity of the existing private driveways on Nimble Hill Road to the southbound off-ramp layout creating potential safety and operational problems, a 0.1-mile section of Nimble Hill Road would be relocated behind the existing Exxon service station as part of the Nimble Hill Road extension south to the new Connector Road. (Retaining the Exit 4 southbound on-ramp in conjunction with a

possible southbound off-ramp was not considered because of the poor traffic operations (weaving) that would result due to vehicles entering and exiting the Turnpike between the proposed Exit 3 (Woodbury Avenue) southbound off-ramp and the Exit 4 southbound on-ramp.)

Dover Segment

The Dover Segment begins immediately north of the Bridge Segment and is approximately 0.9 of a mile in length. This Segment extends north from the Exit 5 Interchange to just south of the Dover Toll Plaza and includes the connections to Hilton Park, Boston Harbor Road and Dover Point Road and the Exit 6 Interchange (**Figure 4.4-1**). The major elements of this Segment involve the widening and/or realignment of the Spaulding Turnpike from the existing four lanes to six or eight lanes; improved access to the Spaulding Turnpike from the adjacent roadways such as US 4, Boston Harbor Road, and Dover Point Road (both on the east and west side of the Turnpike); and improved local connections by providing for full east/west connectivity at the Exit 6 Interchange, at Hilton Park and between the local roads on both sides of the Turnpike at Dover Point.

Within the Dover Segment, the Spaulding Turnpike mainline alignment would be essentially the same for all three Dover alternatives. All alternatives would utilize a 6-lane or a combination of six and eight mainline travel lanes except where additional traffic management lanes may be necessary to accommodate traffic entering/merging and/or diverging/exiting at the proposed Exit 6 Interchange. The proposed mainline improvements for all three alternatives would begin approximately 0.4 of a mile north of the Little Bay Bridges at Dover Point at the end of the Bridge Segment, and widen the existing four lanes to either six or eight travel lanes. All the alternatives would eliminate the existing Exit 5 Hilton Park northbound Interchange. The Exit 5 traffic would be re-routed via either a new Connector Road under the Spaulding Turnpike linking Hilton Park and the adjacent residential areas to Dover Point Road/Boston Harbor Road or via an at-grade Connector Road that would parallel the east side of the Turnpike connecting Hilton Park with Dover Point Road on the east.

The proposed Connector Road options that link the easterly and westerly sides of Hilton Park and Dover Point are included as part of the Dover Interchange Alternatives 1, 2, and 3.

Dover Alternative 1

Based upon recommendations from the ATF and Dover officials, Alternative 1 (**Figure 4.4-8**), developed in 2000 as part of the Spaulding Turnpike Improvements Feasibility Study, was carried forward for further evaluation as part of this EIS study process. Alternative 1 involves three basic components - the development of a new full interchange at Exit 6 and Dover Point Road, the elimination of the existing Exit 5 Interchange at Hilton Park and Wentworth Terrace, and establishment of improved local access and connectivity between the east and west sides of Dover Point. The

New Hampshire DOT
Department of Transportation

DURHAM

ROCKINGHAM COUNTY

STRAFFORD COUNTY

LITTLE BAY

SCAMMELL BRIDGE

ROYALS COVE

BOSTON HARBOR RD

SPUR RD

BELLAMY RIVER

TRICKY'S COVE

GENERAL SULLIVAN BRIDGE

HILTON PARK

DOVER POINT RD

EXIT 6

640

650

660

670

680

TOLL PLAZA

POMEROY COVE

620

630

610

600

LITTLE BAY BRIDGES

DOVER POINT

HILTON PARK

WENTWORTH TER

EXIT 5

Bridge Segments

Dover Segments

COTE DR

HILTON RD

HOMESTEAD LN

PINEVIEW DR

SPALDING TURNPIKE

16

BLOODY POINT

NEWINGTON

DOVER

PISCATAQUA RIVER

Legend:

- Existing Pavement
- Building
- Water
- Wetlands
- Conceptual Roadway Improvements
- Proposed Bridge
- 1 or 2 Lane Conceptual Roadway
- Proposed Signal
- 3/4 Proposed Roadway Lanes
- Existing ROW
- Existing Property Lines
- Newington Interim Improvements

0 400 800 Feet

Vanasse Hangen Brustlin, Inc.

Figure 4.4-8
Dover Alternative 1

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proposed Exit 6 Interchange would be a combination diamond and loop-ramp configuration developed to maximize free-flow traffic movements to the extent practicable given the existing resource and property constraints. The interchange involves reconstructing and widening the Turnpike overpass (which currently only accommodates westbound traffic) into a two-way roadway beginning in the vicinity of Pineview Drive and extending westerly over the Spaulding Turnpike for approximately 0.9 of a mile to US 4 at the Scammell Bridge. Signalized intersections would be provided at the US 4/Spur Road/Boston Harbor Road intersection, at the southbound on-ramp for the westbound overpass traffic, and at the Dover Point Road/new northbound on-ramp intersection with the new at-grade Connector Road to Hilton Park. For the Spaulding Turnpike northbound traffic exiting at Exit 6, traffic would leave the Turnpike on a 2-lane off-ramp and onto a collector-distributor road that would split to eastbound and westbound free-flow ramps, which would then merge with Dover Point Road. The Exit 6 existing southbound off-ramp to Spur Road would be retained. The existing southbound on-ramp from Boston Harbor Road would be closed and all traffic would be re-routed northerly along Boston Harbor Road to the signalized intersection with US 4 where traffic would access US 4, Spur Road, Dover Point Road or the southbound on-ramp to the Turnpike. A new northbound on-ramp would be provided from Dover Point Road to the Turnpike just south of the Toll Plaza, which would require the relocation of approximately 0.1 of a mile of Homestead Lane northerly to Pineview Road. The southbound traffic entering onto the Turnpike from Exit 6 would merge onto the widened Turnpike as a 2-lane on-ramp.

With the Exit 5 Interchange and the southbound one-way access road that extends between the General Sullivan Bridge and Little Bay Bridge approaches (under the Little Bay Bridges) eliminated under this alternative, local access to Dover Point, Hilton Park (on the east) and Wentworth Terrace is provided by constructing a new Connector Road beginning in the vicinity of Wentworth Terrace and extending northerly, adjacent to the northbound barrel of the Spaulding Turnpike, approximately 1.0 mile to intersect with Dover Point Road at a signalized intersection opposite the new Exit 6 northbound on-ramp. The existing pathway adjacent to Pomeroy Cove will be incorporated into the new Connector Road.

The Boston Harbor Road and Spur Road approaches are shifted easterly from their current intersection with US 4 to allow for two lanes of traffic storage in each direction at the intersection without requiring widening of the Scammell Bridge over the Bellamy River.

Dover Alternative 2

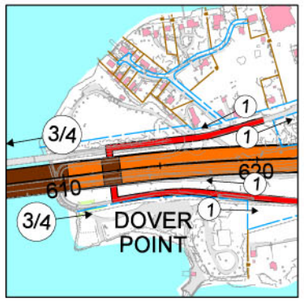
Similar to Alternative 1 described above, Dover Alternative 2 was carried forward from the 2000 Feasibility Study for further evaluation (**Figure 4.4-9**). Alternative 2 involves three basic components: the development of a new full interchange at Exit 6 and Dover Point Road, the elimination of the existing Exit 5 Interchange at Hilton Park and Wentworth Terrace, and the establishment of improved local access and

connectivity between the east and west sides of Dover Point. The proposed Exit 6 Interchange would be a full access diamond-type interchange that would involve reconstructing and widening the Turnpike overpass (which currently only accommodates westbound traffic) into a two-way roadway beginning in the vicinity of Homestead Lane and extending westerly over the Spaulding Turnpike for approximately 0.7 of a mile to US 4 at the Scammell Bridge. Signalized intersections would be provided at the Spur Road/Boston Harbor Road intersection, at the southbound on-ramp (for westbound traffic), at the northbound off and on-ramp intersection, and at the Dover Point Road intersection located just east of the northbound ramps. The Exit 6 existing southbound off-ramp to Spur Road would be retained. The existing southbound on-ramp from Boston Harbor Road would be closed and all traffic would be re-routed northerly along Boston Harbor Road to the signalized intersection with US 4 where traffic would access US 4, Spur Road, Dover Point Road or the southbound on-ramp to the Turnpike. The southbound traffic entering onto the Turnpike from Exit 6 would merge onto the widened Turnpike as a 2-lane on-ramp. A new northbound on-ramp would be provided from Dover Point Road to the Turnpike just south of the Toll Plaza.

With the Exit 5 Interchange and the southbound one-way access road that extends between the General Sullivan Bridge and Little Bay Bridge approaches (and continues east under the Little Bay Bridges) eliminated under this alternative, local access to Dover Point, Hilton Park (on the east) and Wentworth Terrace would be provided by constructing a new Connector Road (two options, the loop connector and the "T" connector are shown in **Figure 4.4-9)** under the Spaulding Turnpike beginning in the vicinity of the entrance to Hilton Park on the west side of the Turnpike and extending approximately 0.5 of a mile to Hilton Park and Wentworth Terrace on the east side of the Turnpike. The existing pathway adjacent to Pomeroy Cove and the northbound lanes of the Turnpike would be retained.

Dover Alternative 3

Alternative 3 (**Figure 4.4-10**) is very similar to Alternative 2, described above, with the exception that Alternative 3 would provide a new Connector Road that would link Spur Road with Boston Harbor Road by passing under US 4 to the west of the southbound on-ramp. This variation of Alternative 2 would allow the elimination of the traffic signal at the Spur Road/Boston Harbor Road intersection and reconfigure it to right-turn access and egress to US 4 only. The modification would allow US 4 eastbound traffic to free-flow onto the Spaulding Turnpike and provide a local connection for motorized and non-motorized traffic free of conflict with interchange-related traffic flows. Alternative 3 involves the same basic components as Alternative 2: the development of a new full interchange at Exit 6 and Dover Point Road, the elimination of the existing Exit 5 Interchange at Hilton Park and Wentworth Terrace, and the establishment of improved local access and connectivity between the east and west sides of Dover Point. The proposed Exit 6 Interchange would be a full access diamond-type interchange that would involve reconstructing and widening the Turnpike overpass (which currently only accommodates westbound traffic) into a



Hilton Park Connector
"T" Intersection

ROCKINGHAM COUNTY

STRAFFORD COUNTY

DURHAM

LITTLE BAY

SCAMMELL BRIDGE

4

ROYALS COVE

BOSTON HARBOR RD

SPUR RD

BELLAMY RIVER

EXIT 6

TRICKY'S COVE

GENERAL SULLIVAN BRIDGE

DOVER POINT RD

HILTON PARK

POMEROY COVE

640

650

630

610

600

590

LITTLE BAY BRIDGES

DOVER POINT

WENTWORTH TER

EXIT 5

Bridge Segments

Dover Segments

COTE DR

HILTON RD

TOLL PLAZA

670

680

HOMESTEAD LN

PINEVIEW DR

SPAULDING TURNPIKE

16

BLOODY POINT

NEWINGTON

DOVER

PISCATAQUA RIVER

New Hampshire DOT
Department of Transportation

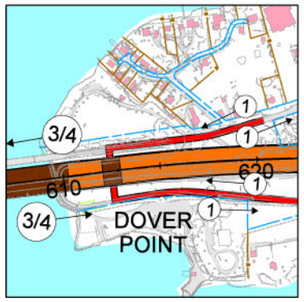
Legend:

- Existing Pavement
- Building
- Water
- Wetlands
- Conceptual Roadway Improvements
- Proposed Bridge
- 1 or 2 Lane Conceptual Roadway
- Proposed Signal
- 3/4 Proposed Roadway Lanes
- Existing ROW
- Existing Property Lines
- Newington Interim Improvements

0 400 800 Feet

Vanasse Hangen Brustlin, Inc.

Figure 4.4-9
Dover Alternative 2



Hilton Park Connector
"T" Intersection

DURHAM

ROCKINGHAM COUNTY

STRAFFORD COUNTY

LITTLE BAY

SCAMMELL BRIDGE

ROYALS COVE

BOSTON HARBOR RD

SPUR RD

BELLAMY RIVER

TRICKY'S COVE

EXIT 6

DOVER POINT RD

GENERAL SULLIVAN BRIDGE

HILTON PARK

POMEROY COVE

EXIT 5

Bridge Segments

Dover Segments

COTE DR

HILTON RD

TOLL PLAZA

LITTLE BAY BRIDGES

DOVER POINT

HILTON PARK

WENTWORTH TER

HOMESTEAD LN

PINEVIEW DR

BLOODY POINT

NEWINGTON

DOVER

PISCATAQUA RIVER

New Hampshire DOT
Department of Transportation

Legend:

- Existing Pavement
- Building
- Water
- Wetlands
- Conceptual Roadway Improvements
- Proposed Bridge
- 1 or 2 Lane Conceptual Roadway
- Proposed Signal
- 3/4 Proposed Roadway Lanes
- Existing ROW
- Existing Property Lines
- Newington Interim Improvements

0 400 800 Feet

Vanasse Hangen Brustlin, Inc.

Figure 4.4-10
Dover Alternative 3

two-way roadway beginning in the vicinity of Homestead Lane and extending westerly over the Spaulding Turnpike for approximately 0.7 of a mile to US 4 at the Scammell Bridge. Signalized intersections would be provided at the southbound on-ramp for the Dover Point Road westbound traffic, at the northbound off and on-ramp intersection, and at the Dover Point Road intersection located just east of the northbound ramps. The Exit 6 existing southbound off-ramp that connects to Spur Road would be retained. The existing southbound on-ramp from Boston Harbor Road would be closed and southbound traffic would be re-routed northerly along Boston Harbor Road to US 4 and the southbound on-ramp to the Spaulding Turnpike. The southbound traffic entering onto the Turnpike from Exit 6 would merge onto the widened Turnpike as a 2-lane on-ramp. A new northbound on-ramp is provided from Dover Point Road to the Turnpike just south of the Toll Plaza.

With the Exit 5 Interchange and the southbound one-way access road that extends between the General Sullivan Bridge and Little Bay Bridge approaches (and continues east under the Little Bay Bridges) eliminated under this alternative, local access to Dover Point, Hilton Park (on the east) and Wentworth Terrace would be provided by constructing a new Connector Road (two options, the loop connector and the "T" connector are shown in **Figure 4.4-10**) under the Spaulding Turnpike beginning in the vicinity of the entrance to Hilton Park on the west side of the Turnpike and extending approximately 0.5 of a mile to Hilton Park and Wentworth Terrace on the east side of the Turnpike. The existing pathway adjacent to Pomeroy Cove and the northbound lanes of the Turnpike would be retained.

4.4.3 Bridge Segment Alternatives with Bridge Options

The 0.9-mile Bridge Segment (**Figure 4.4-1**) begins approximately 0.2 of a mile south of the Little Bay Bridges and ends approximately 0.4 of a mile north of the bridges. Four basic bridge/roadway alignments were considered in the development of the bridge widening and replacement alternatives. The first three alternatives are described as "On-Line" since they would utilize a portion of the existing mainline bridge/roadway footprint, and the fourth alterative is described as "Off-Line" since it would be constructed completely outside the existing mainline footprint west of the existing Little Bay Bridges. The alignments are described as follows:

1. Widen East – this alignment would hold the west edge of the existing roadway at the existing bridges and construct the new wider roadway to the east of this line. (See **Figures 4.4-11 and 4.4-12**)

2. Widen West - this alignment would hold the east edge of the existing roadway at the existing bridges and construct the new wider roadway to the west of this line. (See **Figures 4.4-13 and 4.4-14**)

3. Widen Both Sides – this alignment would hold the existing roadway centerline at the existing bridges and construct the new wider roadway by widening equally on both sides. (See **Figures 4.4-15 and 4.4-16**)

4. Off-Line – this alignment would construct the new wider roadway approximately 130 feet west of the existing alignment allowing construction of a new bridge in a single phase of construction. (See **Figure 4.4-17**)

For each On-Line alignment (No. 1-3), bridge widening and replacement alternatives were developed. To consider a range of alternatives that reuse versus remove the General Sullivan Bridge, four alternatives were developed for each on-line alignment: a widening alternative and a replacement alternative that retain the General Sullivan Bridge, and a widening alternative and replacement alternative that include a multi-use pathway and removal of the General Sullivan Bridge.

For the Off-Line alignment (No. 4), two "signature" bridge replacement alternatives were developed. These alternatives were developed at the request of the ATF to provide a distinctive gateway between the two communities and to potentially mitigate the removal of the General Sullivan Bridge. (See **Figure 4.4-18**)

The bridge constructions for the various alternatives are described below:

Little Bay Bridges - Widening Alternatives

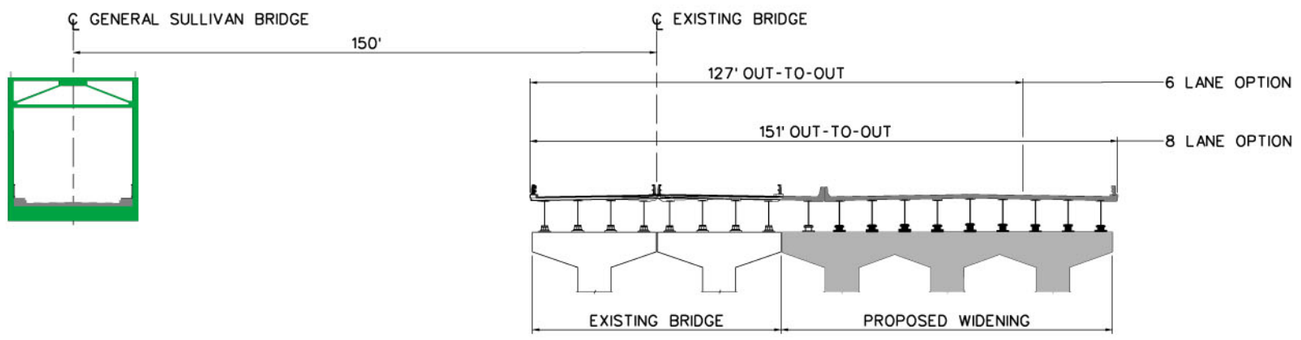
The construction for the bridge widening alternatives, with or without a multi-use path would consist of widening the existing Little Bay Bridges using concrete piers, haunched steel girders, and a concrete deck. The new construction would visually match the appearance of the existing bridges and the existing profile (60 MPH design speed would be maintained). While maintaining the existing vertical clearance over the waterway, the existing Little Bay Bridges would be rehabilitated including replacing the bridge deck, modifying the steel girders to upgrade the pin and hanger connections, repainting the steel girders, and seismically retrofitting the existing pier columns. The construction would occur in phases, maintaining traffic on the existing bridges during construction of the widening, and moving the traffic to the widened section of the bridge during rehabilitation of the existing bridges. The Widen East and Widen West Alternatives could be constructed in two phases; the Widen Both Sides would require three phases of construction. These alternatives have the lowest construction costs since they reuse the existing bridges.

Little Bay Bridges – Replacement On-Line

The construction of the on-line replacement bridge alternatives, with or without a multi-use path, would consist of removal of the existing Little Bay Bridges and construction of a new bridge using concrete piers, haunched steel girders, and a concrete deck. The new construction would be visually similar to the appearance of the existing bridges. These alternatives would improve the stopping sight distance over the bridge to a 70 MPH design speed which would require raising the bridge

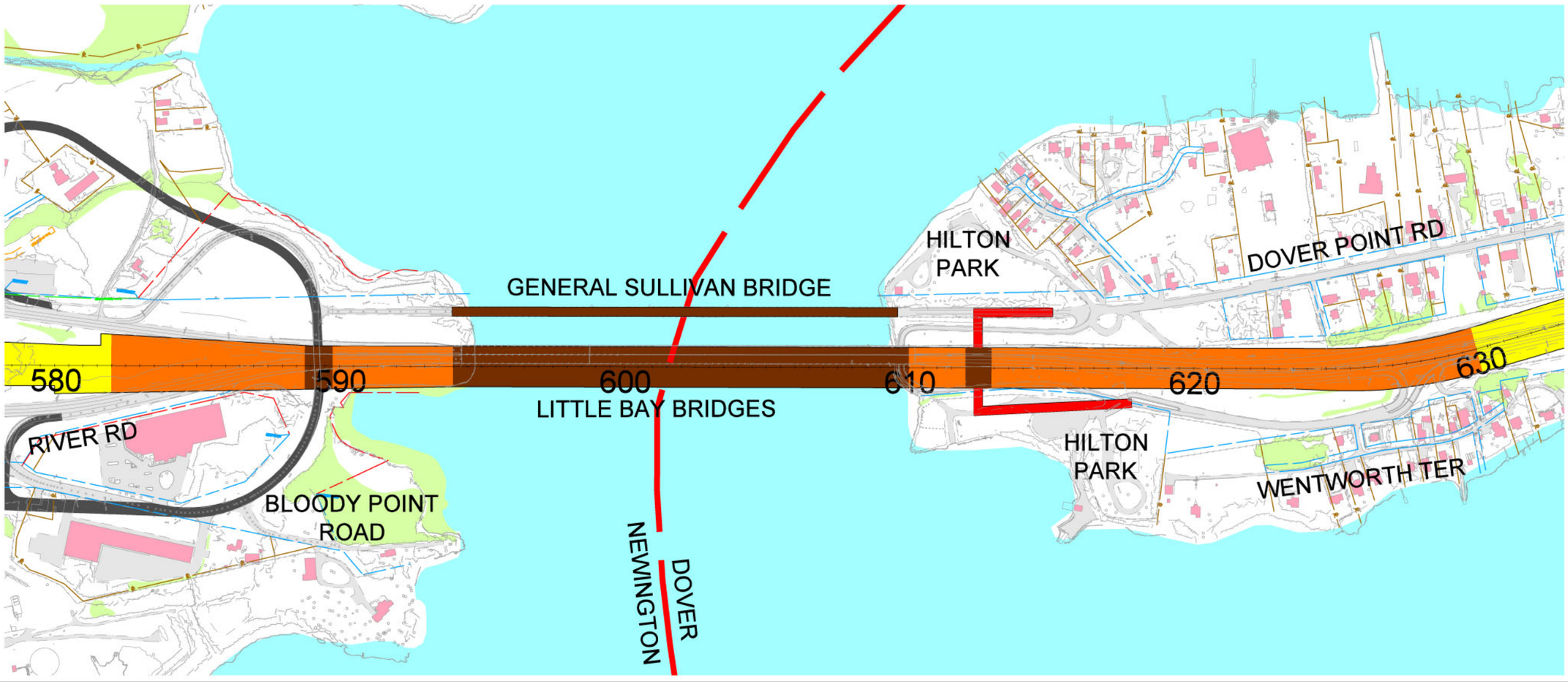
New Hampshire DOT
Department of Transportation

Conceptual Cross-Section



Legend:

- Existing Pavement
- Building
- Water
- Wetlands
- Conceptual Roadway Improvements
- 1 or 2 Lane Conceptual Roadway
- Proposed Bridge
- Newington Interim Improvements



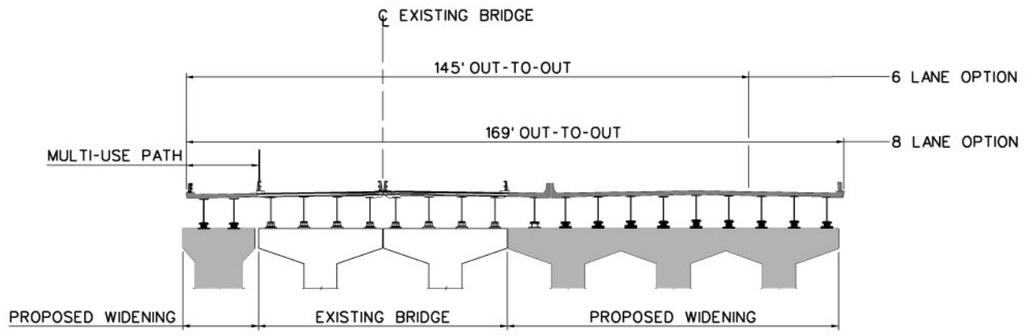
0 200 400 Feet

Vanasse Hangen Brustlin, Inc.

Figure 4.4-11
Widen Little Bay Bridge to East Side and Rehabilitate General Sullivan Bridge

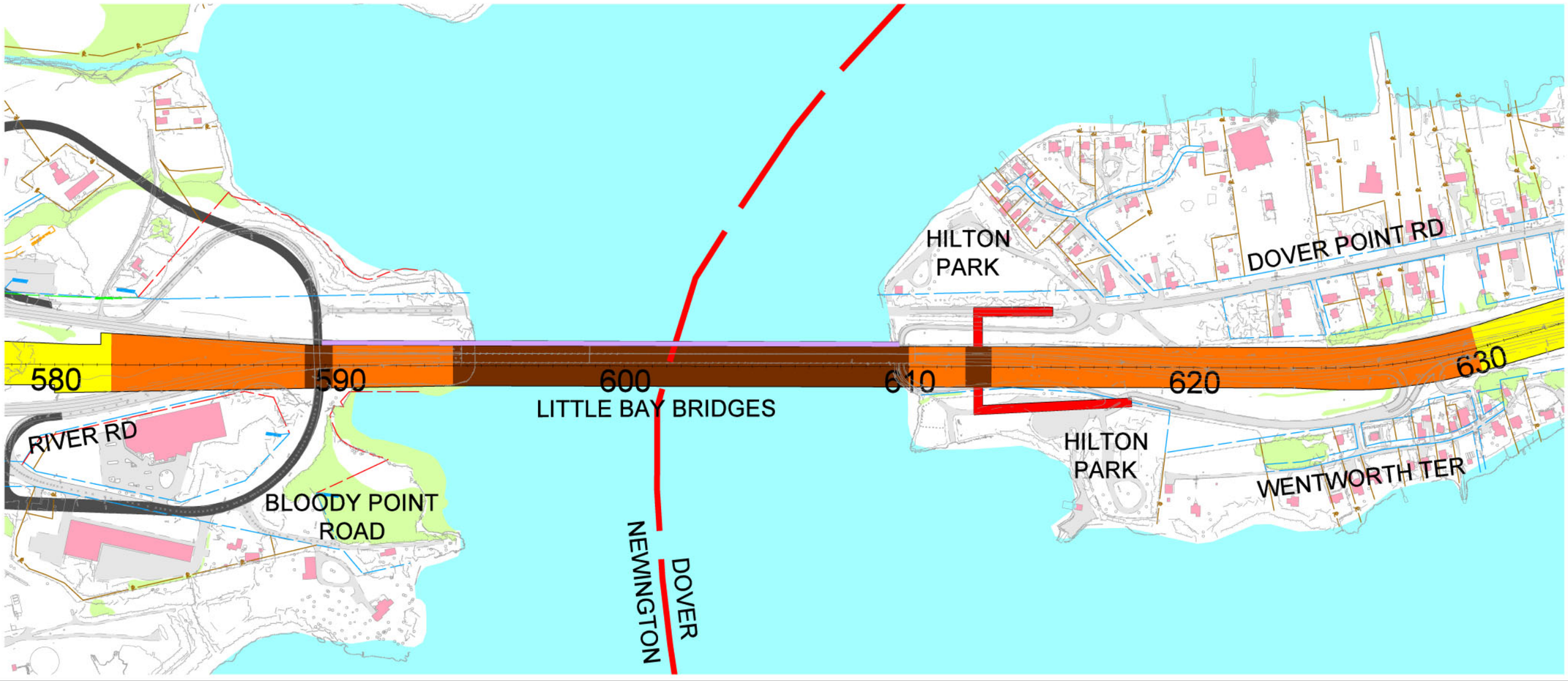
New Hampshire DOT
Department of Transportation

Conceptual Cross-Section



Legend:

- Existing Pavement
- Building
- Water
- Wetlands
- Conceptual Roadway Improvements
- 1 or 2 Lane Conceptual Roadway
- Proposed Bridge
- Multi-use Pathway
- Newington Interim Improvements



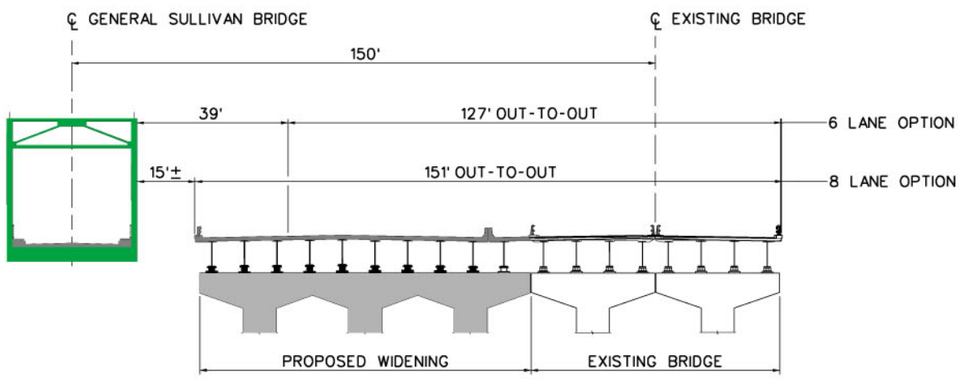
0 200 400 Feet

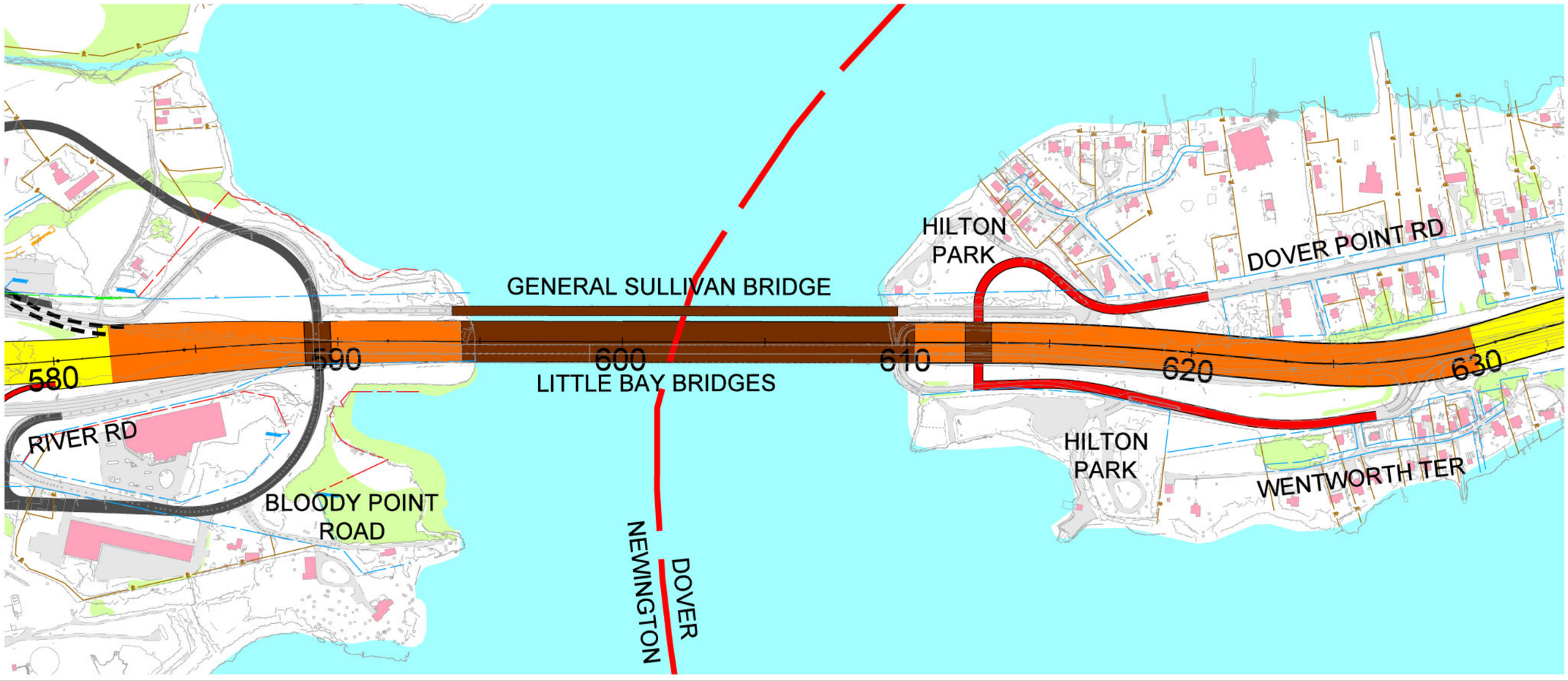
Vanasse Hangen Brustlin, Inc.

Figure 4.4-12
Widen Little Bay Bridge to East Side with Multi-Use Path and Remove General Sullivan Bridge

New Hampshire DOT
Department of Transportation

Conceptual Cross-Section





Legend:

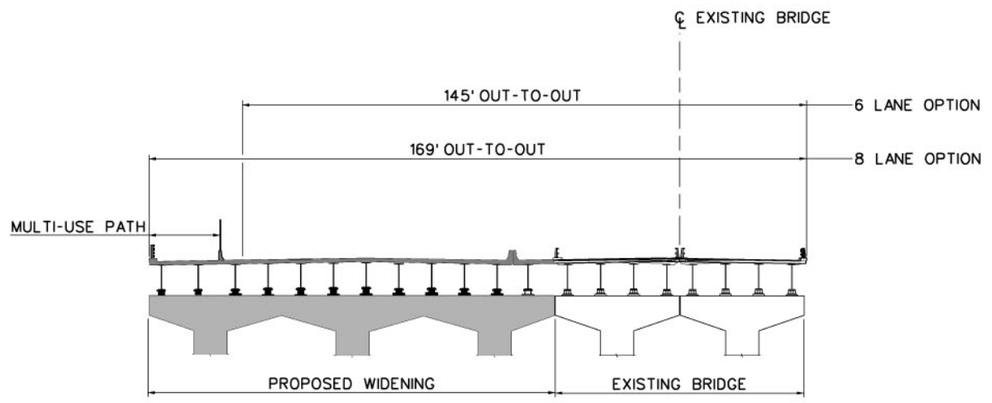
- Existing Pavement
- Building
- Water
- Wetlands
- Conceptual Roadway Improvements
- 1 or 2 Lane Conceptual Roadway
- Proposed Bridge
- Newington Interim Improvements

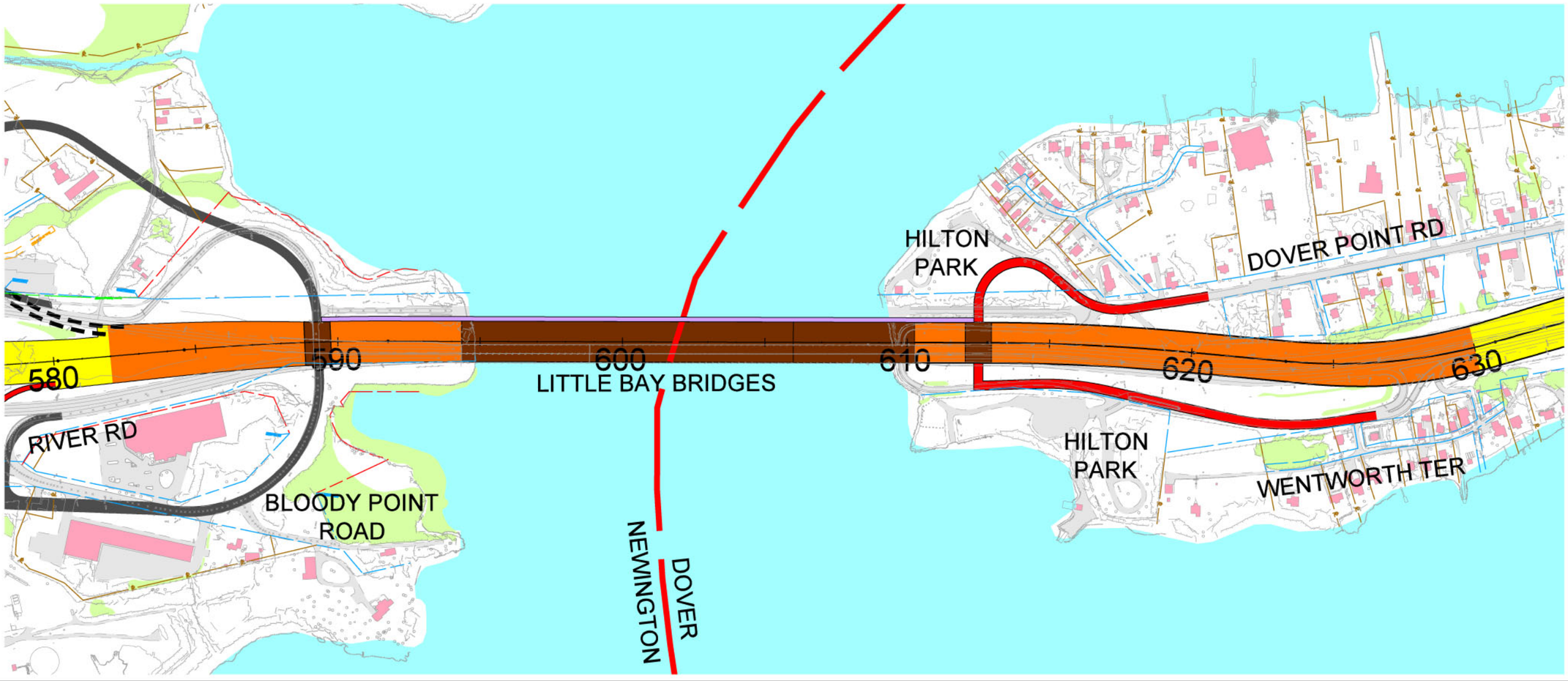
Vanasse Hangen Brustlin, Inc.

Figure 4.4-13
Widen Little Bay Bridge to West Side and Rehabilitate General Sullivan Bridge

New Hampshire DOT
Department of Transportation

Conceptual Cross-Section





Legend:

- Existing Pavement
- Building
- Water
- Wetlands
- Conceptual Roadway Improvements
- 1 or 2 Lane Conceptual Roadway
- Proposed Bridge
- Multi-use Pathway
- Newington Interim Improvements

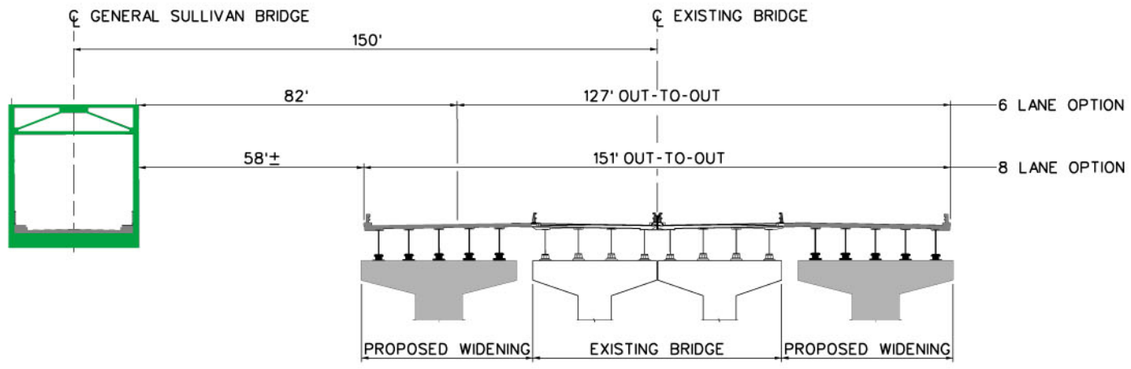
0 200 400 Feet

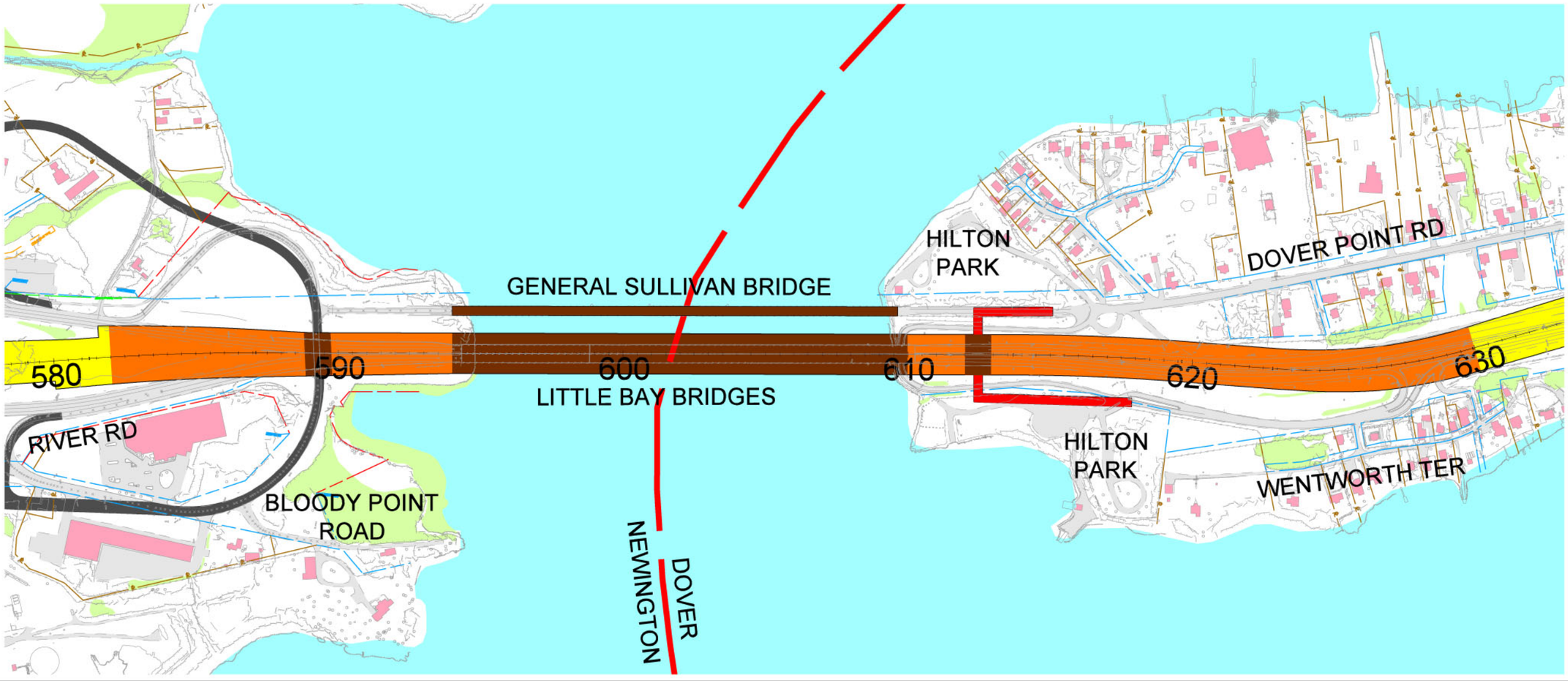
Vanasse Hangen Brustlin, Inc.

Figure 4.4-14
Widen Little Bay Bridge to West with Multi-Use Path and Remove General Sullivan Bridge

New Hampshire DOT
Department of Transportation

Conceptual Cross-Section





Legend:

- Existing Pavement
- Building
- Water
- Wetlands
- Conceptual Roadway Improvements
- 1 or 2 Lane Conceptual Roadway
- Proposed Bridge
- Newington Interim Improvements

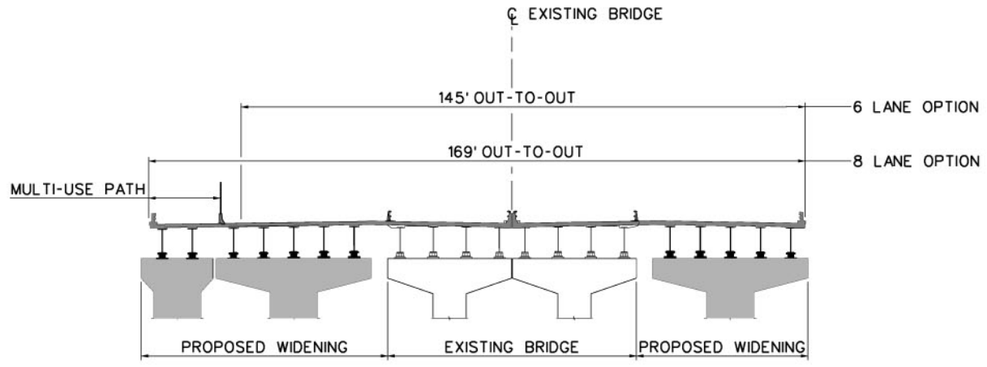
0 200 400 Feet

Vanasse Hangen Brustlin, Inc.

Figure 4.4-15
Widen Little Bay Bridge to Both Sides and Rehabilitate General Sullivan Bridge

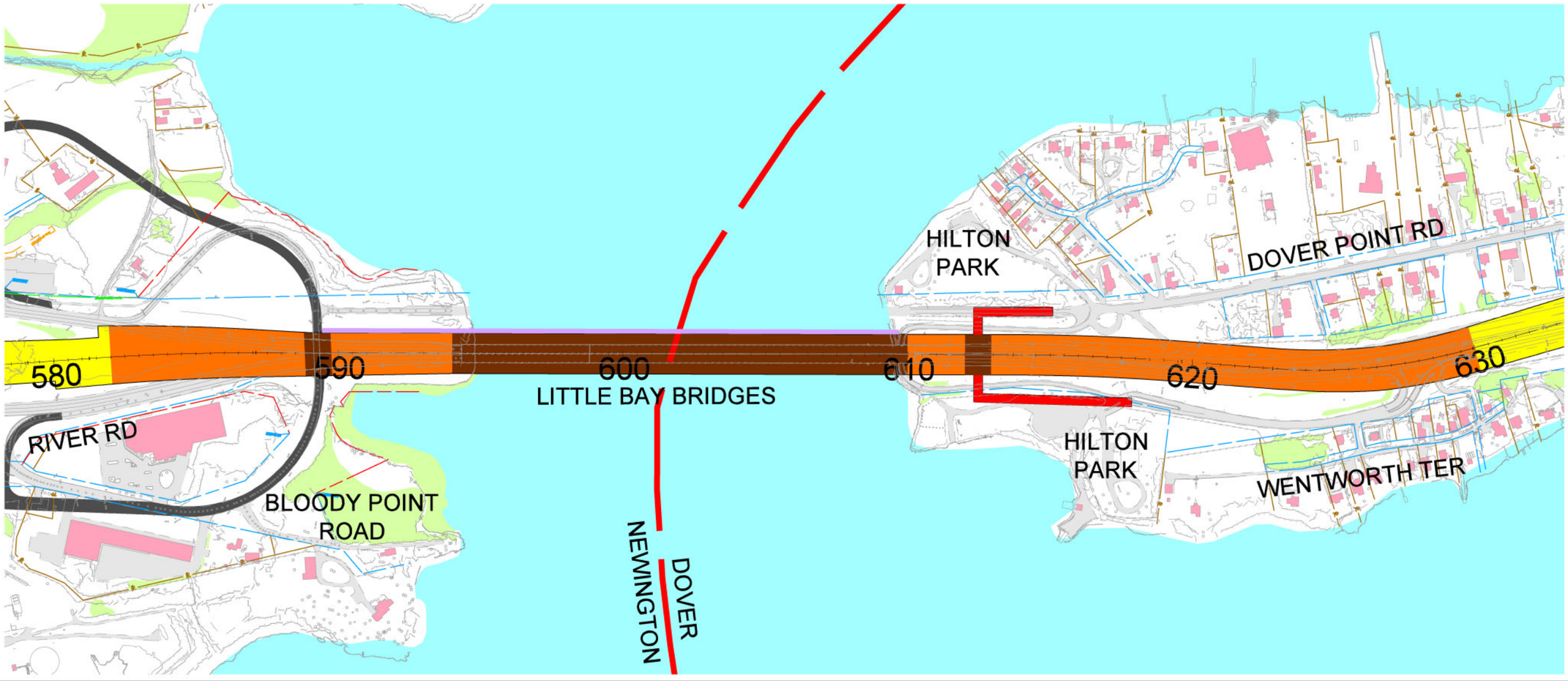
New Hampshire DOT
Department of Transportation

Conceptual Cross-Section



Legend:

- Existing Pavement
- Building
- Water
- Wetlands
- Conceptual Roadway Improvements
- 1 or 2 Lane Conceptual Roadway
- Proposed Bridge
- Multi-use Pathway
- Newington Interim Improvements



0 200 400 Feet

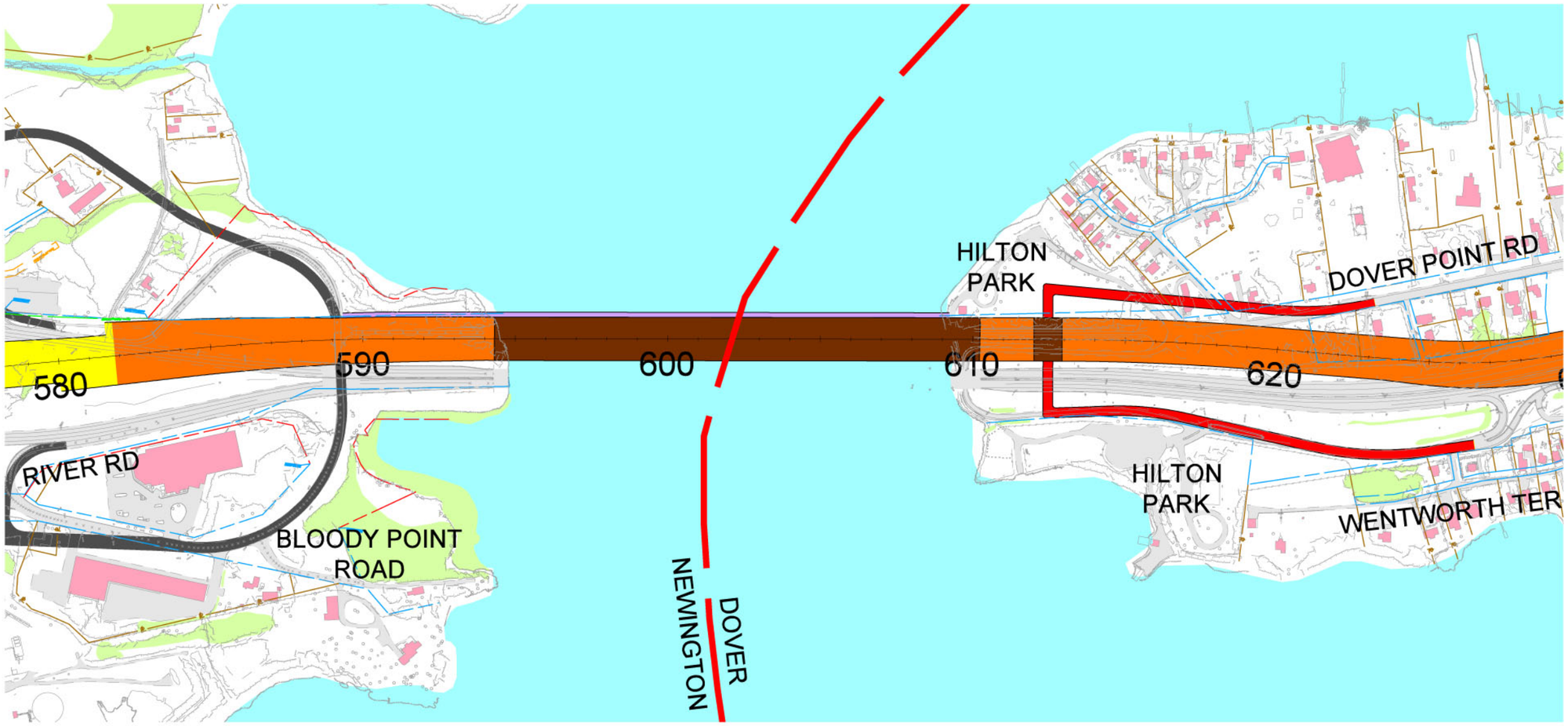
Vanasse Hangen Brustlin, Inc.

Figure 4.4-16
Widen Little Bay Bridge to Both Sides with Multi-Use Path - Remove General Sullivan Bridge

New Hampshire DOT
Department of Transportation

Legend:

- Existing Pavement
- Building
- Water
- Wetlands
- Conceptual Roadway Improvements
- 1 or 2 Lane Conceptual Roadway
- Proposed Bridge
- Multi-use Pathway
- Newington Interim Improvements



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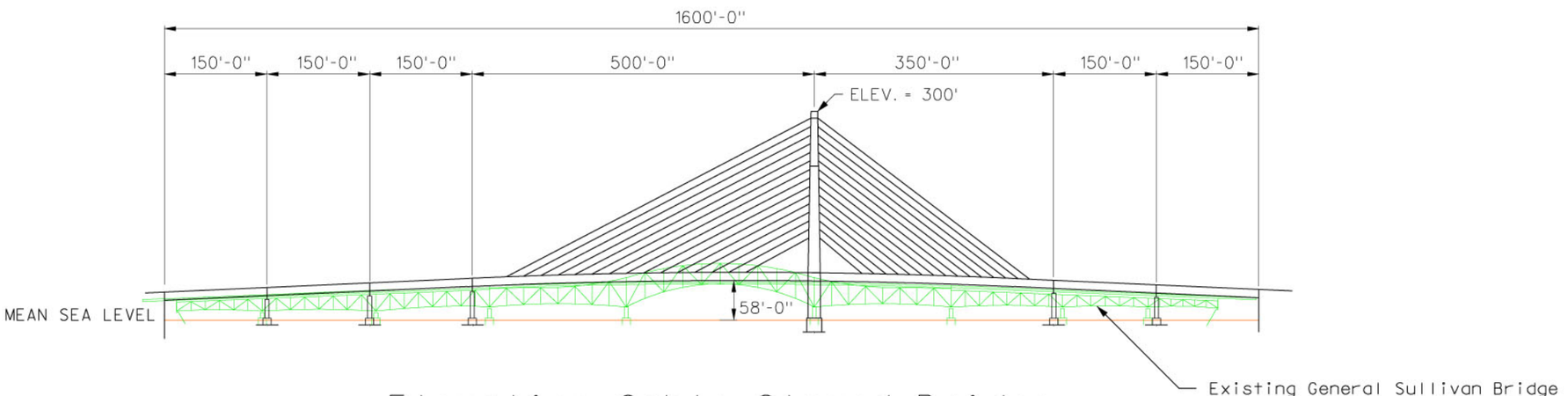
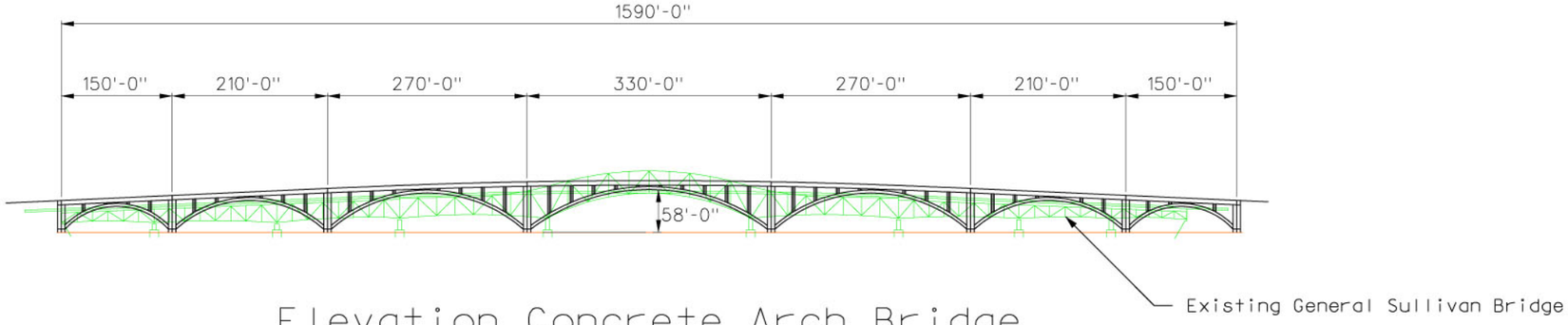
Vanasse Hangen Brustlin, Inc.

Figure 4.4-17
Construct New Bridge with Multi-Use Path - Replace Little Bay Bridges and General Sullivan Bridge



Elevation Cable-Stayed Bridge

N.T.S.



Elevation Concrete Arch Bridge

N.T.S.

Figure 4.4-18
Conceptual Elevations of
New Signature Bridge Structure

elevation approximately 5 feet at the abutments. The new bridges would be constructed in phases and traffic maintained in the same manner as for the rehabilitation alternatives. Maintenance of traffic would be more difficult than the rehabilitation options due to the profile raise.

Little Bay Bridges – Replacement Off-Line

The off-line bridge replacement alternatives include two "signature" structures. To qualify as signature structures, these alternatives should present unique visual elements in the bridge. The first signature alternative consists of multiple concrete arches supporting the bridge deck. This structure presents a dramatic appearance from Hilton Park and River Road, but would go largely unnoticed by the traffic traveling over the bridge. The second signature option consists of a cable-stayed bridge which would present a dramatic appearance due to the height of the central tower and the harped cables extending to the bridge deck. This alternative would be visible from Hilton Park and from the traffic traveling over the bridge. Due to the proximity to the Pease Tradeport, the height of a cable-stayed option may need to be limited in order to conform to airspace restrictions. The width of the proposed structure would also be greater than typical for this type of structure. These alternatives would be more expensive due to their unique construction requirements. A 70 MPH (design speed) stopping sight distance can be provided on these structures.

General Sullivan Bridge

The General Sullivan Bridge has been closed to motorized vehicular traffic since 1984. The bridge has experienced considerable deterioration, including deck, girder and truss members, extensive substructure (pier) deterioration below the water line, impacted rust in the truss connections, loss of section on the floor beams, and peeling of the lead paint system on the bridge. The bridge will require major rehabilitation in order to remain as a functioning part of the transportation system for motorized vehicles or bicycles and pedestrians. Rehabilitation costs are estimated at $19 to $22 million depending on the type of traffic it will support. In addition, the future maintenance costs for this structure would be higher than for conventional structures. The cost to remove the General Sullivan Bridge is estimated to be $5 million.

4.5 Transportation System Management Alternatives

Transportation System Management (TSM) improvements are relatively low-cost measures that are implemented to reduce congestion and improve safety. TSM improvements are typically limited by the width of the existing right-of-way. Examples of TSM improvements include the construction of turning lanes, restriping lane uses, signage, the installation of new or upgrade of existing traffic signals, and other traffic controls such as roundabouts. In addition, TSM improvements could involve the utilization of Intelligent Transportation Systems (ITS) technology, such as

variable message boards and emergency communications, to ease congestion and enhance safety.

As previously stated in Chapter 2, TSM improvements are not in and of themselves the solution to the long-term needs of the Spaulding Turnpike study area. They will, however, provide immediate relief to localized deficiencies in advance of the long-term solutions to be approved and constructed.

4.5.1 TSM Improvements

As part of the study to develop a long-term transportation improvement plan for the Spaulding Turnpike study area – north of Exit 1 (Gosling Road) in Newington to south of the Dover Toll Plaza – a number of TSM-type actions to improve existing safety and traffic operational conditions in the study area were identified and evaluated. These improvements would be relatively inexpensive and could be implemented within the existing right-of-way and in a phased manner over a relatively short time frame. The following program of TSM actions was endorsed by the ATF at their March 31, 2004 meeting:

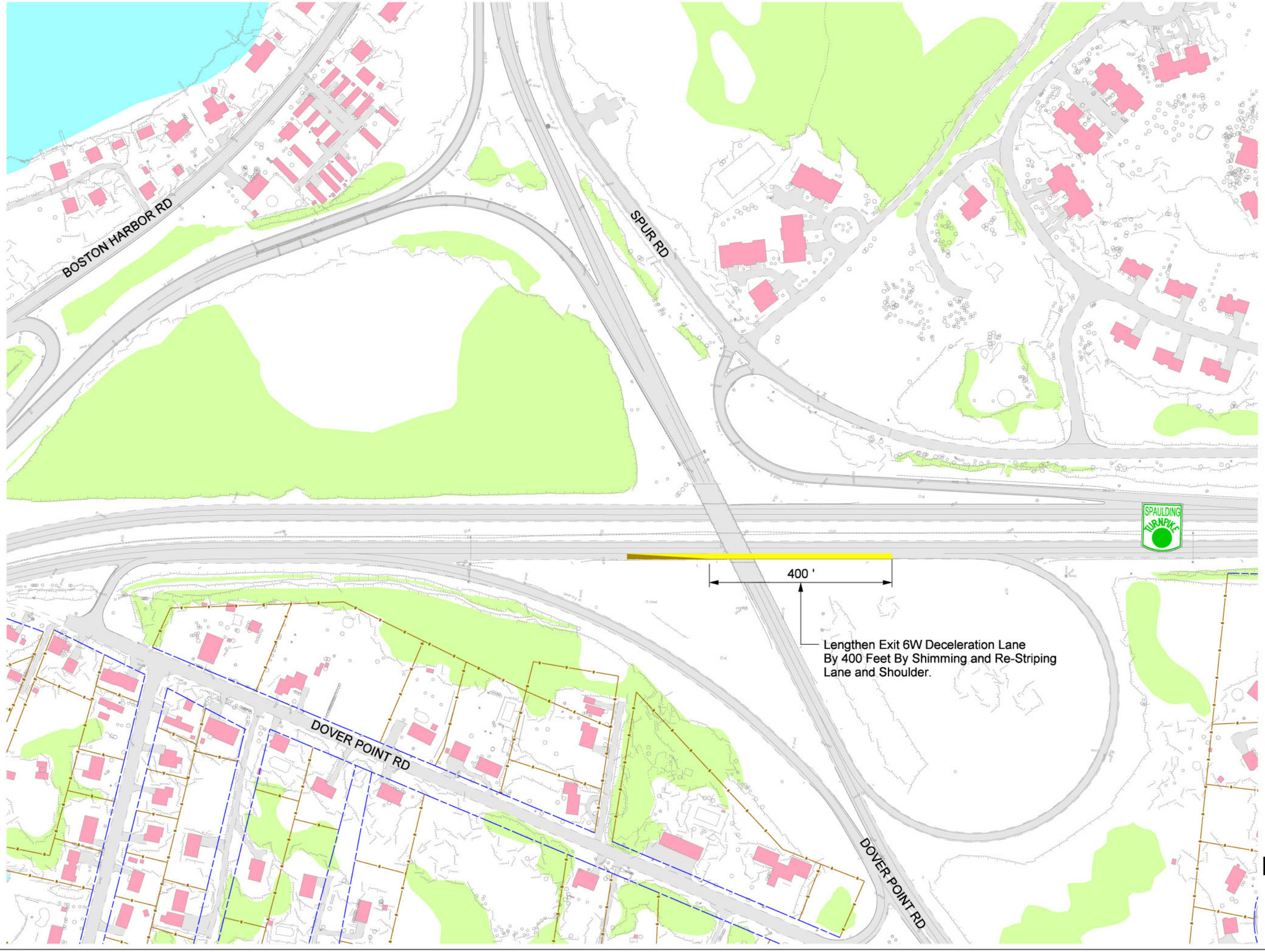
- Dover Exit 6, Northbound
- Dover, Exit 6, Southbound
- Newington, Exit 3, Southbound
- Newington, Exits 3-4, Northbound
- Signage

Dover, Exit 6, Northbound

This action, as depicted in **Figure 4.5-1**, would extend the northbound Exit 6W deceleration lane to the US 4 westbound loop ramp by approximately 400 feet to prevent weekday evening peak hour exiting traffic from queuing back onto the northbound through lane traffic. This modification can be implemented within the existing shoulder area without affecting the bridge abutment, and will improve 2005 LOS from D to C.

Dover, Exit 6, Southbound

This action, as depicted in **Figure 4.5-2** involves merging the 2-lane southbound on-ramp at Exit 6 to a single lane prior to the merge with the mainline, coupled with carrying two through lanes on the Turnpike through the Exit 6 Interchange to merge with the single southbound on-ramp. Currently the two through lanes merge to a single lane. Current traffic volumes on the mainline (approximately 2,500 vehicles, morning peak hour) warrant the two lanes, and the approximately 1,500 vehicles entering on the southbound on-ramp can be accommodated in a single lane. The single lane merge operation will be an improvement in comparison to existing conditions. The proposed changes will make it safer and easier for drivers to be in the proper lanes (either outside or inside) when planning to exit at Nimble Hill Road



New Hampshire DOT
Department of Transportation

Legend:

- Existing Pavement
- Building
- Water
- Wetlands
- Conceptual Roadway Improvements
- Proposed Shoulder

0 100 200 Feet

Vanasse Hangen Brustlin, Inc.

Figure 4.5-1
Dover TSM
Exit 6, Northbound

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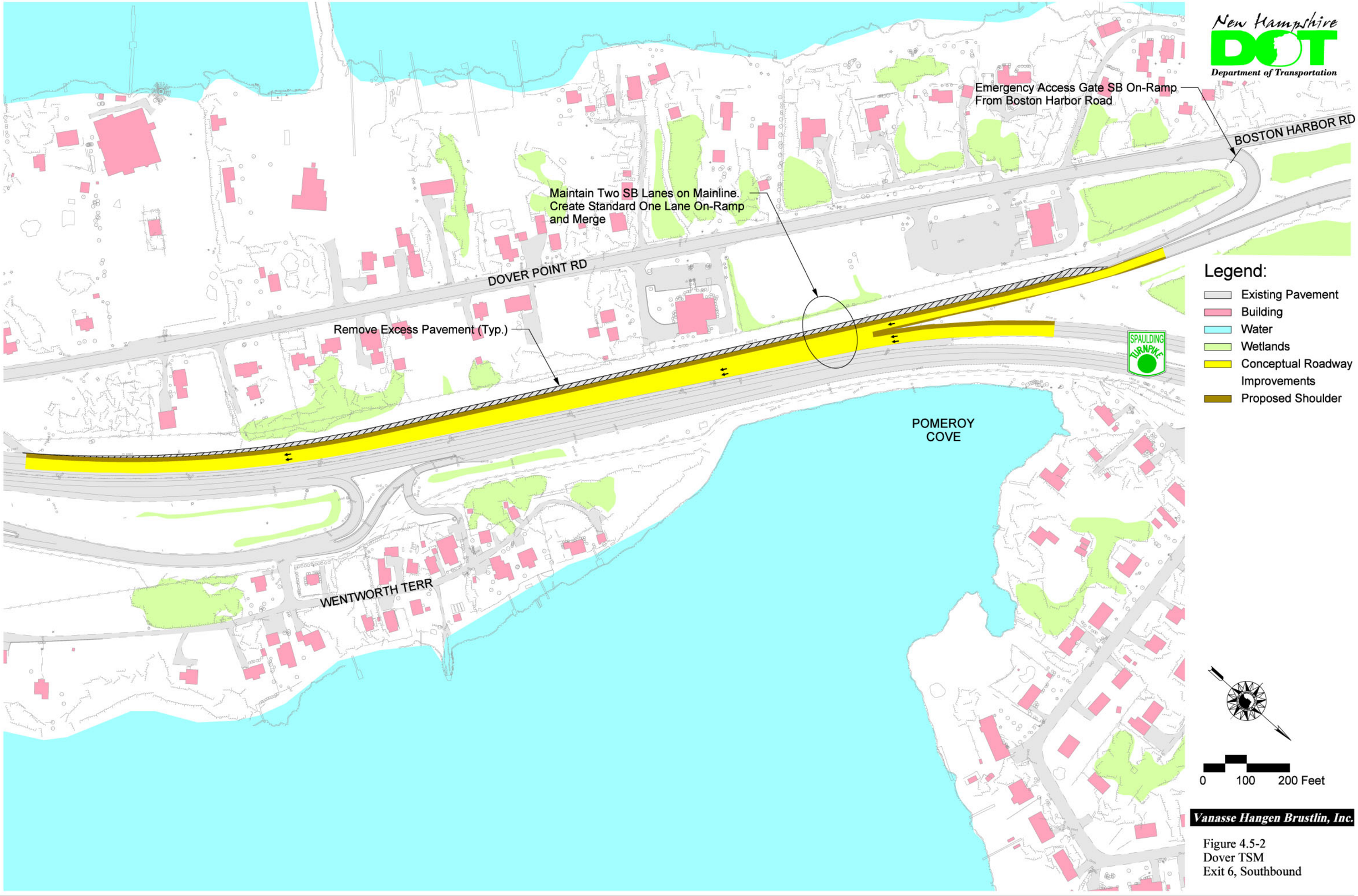


Vanasse Hangen Brustlin, Inc.

Figure 4.5-2
Dover TSM
Exit 6, Southbound

(Exit 4) or Woodbury Avenue (Exit 3). It should be noted that the existing on-ramp from Boston Harbor Road will be closed. Traffic from Boston Harbor Road and Dover Point Road will access the Turnpike via the traffic signal at Spur Road and the southbound on-ramp from US 4. While improving the merge condition (LOS D) and reducing the vehicle delays and queuing on both the on-ramp and mainline in comparison to existing conditions, the TSM action will not eliminate the capacity condition on the Little Bay Bridges.

Newington Interim Safety Improvements

The Interim Safety Plan (**Figure 4.5-3**) will address the current safety and traffic operational problems at Nimble Hill Road and at River Road due to inadequate weaving distances between these roadways and the median southbound to northbound turnaround (Exit 4N) on the Turnpike. By providing a two-way, grade-separated connection under the Turnpike, between Nimble Hill Road and River Road, the median turnaround can be eliminated, thus eliminating the current weaving conditions. The existing southbound on-ramp from the grade-separated turnaround from River Road will also be eliminated which will remove another inadequate weave and merge condition, thus improving safety and traffic operations in the area. This project is under final design and scheduled for construction in 2005.

Newington, Exit 3, Southbound

Figure 4.5-4 depicts the recommended TSM actions in Newington. Assuming implementation of the Newington Interim Safety Improvements (2005 scheduled construction) which eliminates the southbound to northbound turnaround in the median (Exit 4N), the existing Exit 3 southbound deceleration lane to Woodbury Avenue can be extended by approximately 600 feet, improving 2005 LOS from E to D.

Newington, Exits 3 and 4, Northbound

Assuming implementation of the Newington Interim Safety Improvements, development of a northbound auxiliary lane between Exit 3 and Exit 4 is proposed (**Figure 4.5-4**). Under this concept, the northbound on-ramp from Woodbury Avenue would be lengthened to create an auxiliary lane extending from the Exit 3 on-ramp to the Exit 4 off-ramp. Currently, the merge from Woodbury Avenue, coupled with the merge from the southbound to northbound median U-Turn on the high speed/inside through lane and the weaving of traffic from this median on-ramp to the River Road off-ramp, create congestion during the PM peak hour. This congestion causes northbound traffic to queue back through the Exit 2 Interchange area, and results in some Woodbury Avenue traffic diverting to Shattuck Way/River Road via Patterson Lane in an effort to bypass the queued Turnpike traffic and rejoin the Turnpike via the Exit 4 on-ramp. With the elimination of the merging and weaving traffic that currently reverses direction and enters the northbound traffic flow from the median, and the extension of the northbound auxiliary lane from Woodbury Avenue to River Road, the Woodbury Avenue merge of traffic and the exit of traffic at River Road will be improved, and delays and queuing of northbound through traffic reduced.

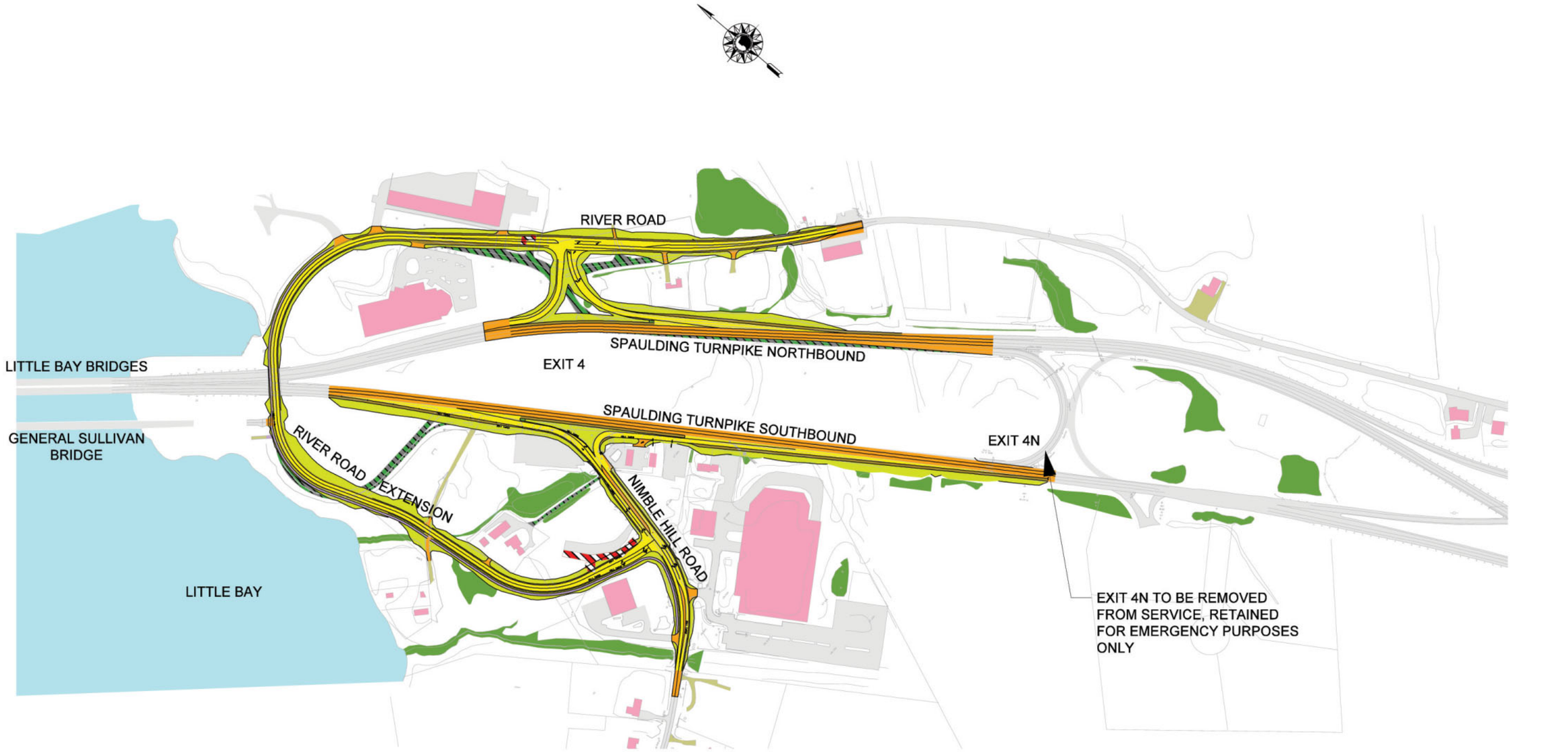
In conjunction with development of the auxiliary lane, the access from Woodbury Avenue to Shattuck Way/River Road via the River Road/Patterson Lane connection could be closed (connection can be gated for emergency access) to prevent Turnpike traffic from diverting to River Road to bypass the congestion on the Turnpike only to rejoin the Turnpike at Exit 4. If the Woodbury Avenue-to-Spaulding Turnpike traffic continues to divert to Shattuck Way/River Road, following implementation of the proposed TSM improvements, then ramp-metering via a new traffic signal at the River Road/Exit 4 on-ramp could be considered to meter on-ramp traffic and discourage non-industrial area generated traffic from diverting to River Road to access the Turnpike.

The proposed northbound auxiliary lane is currently being included as part of the Newington Interim Safety Improvements and scheduled for construction in 2005.

Signage

To reinforce the safety importance of not changing lanes on the Little Bay Bridges and their approaches, it is recommended that existing "Stay In Lane" signs be upgraded to make them more prominent.

It is also recommended that directional signage on the northbound approach to Exit 6 be improved to provide drivers with greater recognition and increased decision-making time as they approach the Exit 6E and 6W off-ramps. Currently, some drivers desiring to go west on US 4 or connect to Boston Harbor Road and Dover Point Road mistakenly take the first exit ramp (6E) and then reverse direction in proximity to the ramp terminal area on Dover Point Road.



Proposed Work
Existing Pavement
Wetlands
Resurfacing / Driveway Improvements
Existing Buildings
Water
Buildings to be Removed
Pavement Removal

Interim Safety Improvements

Proposed Interchange Improvements
Exit 4 / River Road / Nimble Hill Road
Newington, New Hampshire
A000(115), 11238-C

New Hampshire DOT Department of Transportation

Figure 4.5-3

New Hampshire DOT
Department of Transportation

Legend:

- Existing Pavement
- Building
- Water
- Wetlands
- Conceptual Roadway Improvements
- Proposed Shoulder

Restrict Access to Emergency Access (Gate) Only

Extend Parallel Exit 3 Southbound Decel Lane

Create Auxiliary Lane Northbound Between Exit 3 and Exit 4

Signalize Proposed Interim Improvement Intersection To Meter NB On-Ramp Traffic (Future - If Necessary)

WOODBURY AVE

SHATTUCK WAY

PATTERSON LN

NIMBLE HILL RD

RIVER RD

SPAULDING TURNPIKE

0 150 300 Feet

Vanasse Hangen Brustlin, Inc.

Figure 4.5-4
Newington TSM Options
Exit 3, Southbound &
Exits 3-4, Northbound

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5

Evaluation of Bridge and Highway Alternatives

5.1 Introduction

A variety of alternatives have been developed to address the purpose and need of this project. This chapter includes information relative to the evaluation of each of the bridge and highway alternatives presented in Chapter 4, along with the rationale for eliminating certain alternatives from further study. The process for evaluation and review of alternatives used throughout this project is also presented.

The screening of alternatives included consideration of environmental and cultural resources as well as analysis of the engineering constraints and projected traffic operations associated with each alternative. Although this Rationale Report provides a preliminary analysis of these constraints, it is not intended to be a full review of the potential benefits and impacts of any particular alternative. Rather, the Rationale Report provides a macro-level screening to help narrow the list of possible alternatives to those that comprise a "reasonable range of alternatives" as defined by the National Environmental Policy Act (NEPA) and Section 404 of the Clean Water Act (CWA). Thus, while the macro-level screening helps define the list of alternatives to be carried forward, a more detailed analysis of these alternatives will be presented in the Draft Environmental Impact Statement (DEIS).

5.2 Public Review of Alternatives

In accordance with NEPA, the review of alternatives for the Newington-Dover project has included a process for review and input by the public, as well as regulatory agencies. A number of meetings were held by the NHDOT and the FHWA as the project progressed from initial conceptual ideas to a more comprehensive and defined set of alternatives. This section describes the variety of meetings conducted as part of this review process during which information was presented or distributed to the various agencies or general public in attendance.

5.2.1 NHDOT and FHWA Oversight

The NHDOT and the FHWA are the responsible state and federal agencies for oversight and development of the EIS for the Newington-Dover project. These agencies also provide support and technical review for this project, particularly in the case of transportation issues. In addition, review and input is sought from the Federal Transit Administration, Regional Planning Commissions, and staff that reside within the local communities. Review meetings serve as a preliminary forum to consider all project related materials, ideas and design concepts developed.

The project team, including NHDOT's consultants, meets periodically to review project-related information and solicit input regarding highway design criteria, alternatives for the Little Bay and General Sullivan Bridges, alternative roadway designs, and alternatives incorporating TSM and TDM measures. In response, revisions were made or additional studies conducted, as appropriate, to supplement the study.

5.2.2 State and Federal Resource Agencies

Another level of review includes both federal and state environmental resource agencies. These agencies are responsible for making or reviewing permitting decisions based on state and federal laws and regulations, and ultimately serve to protect natural, cultural, and socio-economic resources potentially affected by the project. The agencies are focused on ensuring that the project has the least impacts possible, while providing a practicable solution that meets the project purpose and need.

State resource agencies involved in this project include:

State Agency	State Level Responsibility
NH Department of Environmental Services	Wetlands, Air Quality, Water Quality, Waste Management, Coastal Resource Issues and Coastal Zone Management Consistency
NH Natural Heritage Bureau	Threatened or Endangered Plant Species
NH Division of Historical Resources	Historical and Archeological Resources
NH Office of Energy and Planning	Floodplains, Land Use Planning

State Agency	State Level Responsibility
NH Department of Safety, Bureau of Emergency Management	Floodplain Emergency Response
NH Fish & Game Department	Fisheries, Wildlife, Threatened or Endangered Wildlife Species
NH Department of Resources & Economic Development	Parks and Recreation

Federal resource agencies involved in this project include:

Federal Agency	Federal Level Responsibility
US Environmental Protection Agency – Region 1	Wetlands, Air Quality, Water Quality
US Army Corps of Engineers	Wetlands, Water Quality, Historic and Archeological Resources
US Fish & Wildlife Service	Fisheries, Wildlife, Threatened or Endangered Species
Federal Emergency Management Agency	Floodplains
National Marine Fisheries Service	Fisheries
US Coast Guard	Marine Navigation
Federal Aviation Administration	Air Traffic Control, Pease Tradeport

As discussed in the Scoping Report issued in March 2004, early coordination with resource agencies was established in the context of the NEPA scoping process. A formal Notice of Intent to prepare an EIS was published in the Federal Register on May 13, 2003. Following this official notice, a Scoping Meeting was held on June 25, 2003 with the public as well as all local, state, and federal agencies invited to attend. This initial Scoping Meeting provided an opportunity to formally take comment on the purpose and need of the project, the study area under consideration, the alternatives being considered and the key issues involved. In August 2004, following recognition of their role in the Pease Tradeport, consultation with the Federal Aviation Administration was initiated.

Since that initial Scoping Meeting, seven Resource Agency Meetings have been held to provide an opportunity for the agencies to review the development and screening

of project alternatives. These meetings are typically held at NHDOT headquarters in Concord. The most recent Resource Agency Meeting, however, was held on August 5, 2004 in Newington with the intent of providing a more convenient forum for members of the public or local officials who may have wanted to attend, and an opportunity for Resource Agency staff to observe areas of concern within the study area. Actual dates and locations of these meetings are listed in Appendix A of this report along with the topics of discussion.

5.2.3 Advisory Task Force

An Advisory Task Force (ATF) was established early in the project process to provide a forum for the local communities to be closely involved with the technical review and progression of the EIS. The ATF is made up of a total of fifteen members. These members represent the general public, state and federal agencies, and interested stakeholders and provide a forum for their constituencies including local residents, Regional Planning Commissions, chambers of commerce, local transit providers, the Pease Development Authority, and the Great Bay Estuarine Research Reserve.

ATF meetings have been held on a regular basis in Dover and Newington since April 2003, approximately every two to three months, to present and distribute project-related information and to listen to stakeholders and address their issues. The meetings are held in the evenings, are open to the general public and public participation is encouraged. The role of the task force is to collect input from their respective constituencies, and to provide input and guidance to the NHDOT in developing a comprehensive solution that will balance the needs of the community and the region, consistent with the purpose and need of the project.

Eight ATF meetings have been held to date within Newington and Dover. Actual dates and locations of these meetings are listed in Appendix A of this report along with the topics of discussion.

5.2.4 Public Informational Meeting

In addition to the oversight and public input generated through the meetings and groups listed above, additional Public Informational Meetings (PIM) were held during the first and second phases of the Newington-Dover EIS. These meetings provided an additional avenue through which the public could offer its comments, ask questions or express concerns about the project to NHDOT, FHWA and their consultants. The June 2003 Project Scoping Meeting served to kickoff the public participation component of the project. Since that time, in addition to the ATF meetings, public informational meetings were held in Dover on November 12, 2003 and on June 30, 2004, and in Newington on July 1, 2004. Items discussed during these meetings included the project purpose and need, the study area, sensitive environmental resources, project alternatives, constraints analysis and the alternatives

proposed for further study in the Draft EIS. (See Appendix A for a summary of meeting highlights.)

5.3 Evaluation of Alternatives

This section outlines the criteria used to evaluate the alternatives. Note that the No-Build Alternative will be carried forward into the DEIS and used as a baseline condition for comparison with the build alternatives carried forward.

In addition to environmental considerations, alternatives were evaluated from safety, traffic operations, system efficiency and local connectivity perspectives. For example, interchange alternatives and options for local roadways and intersections were conceptually developed to eliminate current design deficiencies, and to reflect community goals and needs such as safer access to commercial/industrial areas and residential neighborhoods, in addition to avoiding where possible and minimizing impacts to the environment.

5.3.1 Environmental Considerations

In developing the conceptual alternatives, both engineering and environmental (natural, cultural, and socio-economic resources) constraints were considered. Detailed information on environmental baseline conditions was described in the March 2004 Scoping Report and was subsequently used during the development and screening of alternatives.

The conceptual design of the Newington-Dover roadway and bridge alternatives looked first to avoid environmental resources within the engineering constraints of widening the existing corridor and bridges. Indeed, certain alternatives were ruled out early and not carried forward for detailed study based on their obvious and substantial impacts. One example is the alternative of replacing the Little Bay Bridges to the east of their current alignment. By inspection, it was determined that this alternative would have undue adverse impacts to Hilton Park and the Little Bay marine environment. Thus, a decision was made early on to discard this alternative from further analysis, since a feasible and less impacting alternative (*i.e.* widen/replace to the west) was available.

In other cases, alignments and geometry were adjusted, within current AASHTO and NHDOT standards, to avoid or minimize impacts to important resources and properties. This process is iterative and on-going. It should be expected that alternatives will be further refined throughout the EIS process to reduce environmental impacts to the maximum extent practical.

5.3.1.1 Environmental Screening Methodology

Once a full list of alternatives was developed, a macro-level environmental screening was conducted to assess the relative impacts resulting from the numerous alternatives. The results of the screening are reported in the Summary of Impacts and Costs, Table 5.3-1 for the 3-lane Alternative, and Table 5.3-2 for the 4-lane Alternative. It is important to note that the design of roadway and bridge alternatives was completed only to a conceptual level, as is typical for this phase of the EIS process. That is, only certain design elements were known at the time of the environmental screening. The current designs account for parameters such as the number of lanes, the approximate paved roadway width and the roadway and bridge horizontal geometry. Vertical alignments were conceptually engineered only at key locations (*e.g.*, grade separation of roadways, interchange on-ramps, *etc.*) to check engineering feasibility. Other parameters such as grading and vertical alignment will be developed later in the process, and therefore were not available for the environmental screening. The analysis is therefore necessarily conducted at a macro level, since the designs are essentially two-dimensional in nature at this time.

Certain assumptions were made during the calculation of impacts. Although engineering and grading had not been completed, all alternatives accurately reflect the number of lanes for the mainline roadway, bridge, ramps and local connector roads. A standard offset from the estimated edge of pavement was taken to develop a project footprint used to assess impacts:

Road Type	Footprint (ft from EOP[1])
Mainline Turnpike	60 ft
Ramps	40 ft
Major Road (*e.g.*, US 4)	40 ft
Local Road	20 ft

[1]Edge of pavement.

In addition, the project was divided into three segments for purposes of calculating impacts, designated as follows:

- The Bridge Segment includes not only the bridge itself, but also 0.2-mile and 0.4-mile sections of highway in Newington and Dover, respectively, that would shift as a result of changes in alignment of the Little Bay Bridges (*e.g.*, replace off line, widen west vs. widen both sides);

- The Newington Segment includes all of the study area (approximately 1.7 miles) in Newington, except for the portion included in the Bridge Segment; and

- The Dover Segment includes all of the study area in Dover (approximately 0.9 mile in length) except for the portion included in the Bridge Segment.

See **Figure 4.4-1** for an overview of these study area segments.

Newington - Dover , NH 11238

Three Lane Summary of Roadway and Bridge Impacts / Costs by Alternative

NH Route 16 Spaulding Turnpike Improvements

IMPACTS	UNIT OF MEASUREMENT	NO BUILD	ROADWAY SEGMENT — NEWINGTON [1]							BRIDGE SEGMENTS (INCLUDING APPROACHES) — WIDEN LITTLE BAY BRIDGE — REHABILITATE GENERAL SULLIVAN BRIDGE FOR USE AS MULTI-USE PATHWAY				BRIDGE SEGMENTS — WIDEN LITTLE BAY BRIDGE — INCLUDES NEW MULTI-USE PATHWAY (REMOVE GENERAL SULLIVAN BRIDGE)				BRIDGE SEGMENTS — REPLACE LITTLE BAY BRIDGE — REPLACE ONLINE — REHABILITATE GENERAL SULLIVAN BRIDGE FOR USE AS MULTI-USE PATHWAY				BRIDGE SEGMENTS — REPLACE LITTLE BAY BRIDGE — REPLACE ON-LINE (REMOVE GENERAL SULLIVAN BRIDGE w/ NEW MULTI-USE PATHWAY)				BRIDGE SEGMENTS — REPLACE LITTLE BAY BRIDGE — REPLACE OFF-LINE (WEST)			SEGMENT — DOVER [5]			COMMENTS
			ALT 6 Revised	ALT 7	ALT 8 [1]	ALT 9	ALT 10	ALT 11	ALT 12	WIDEN EAST [2]	WIDEN WEST	WIDEN BOTH SIDES [3]	REHAB. GENERAL SULLIVAN	WIDEN EAST [2]	WIDEN WEST	WIDEN BOTH SIDES [3]	REMOVE GENERAL SULLIVAN	WIDEN EAST [2]	WIDEN WEST	WIDEN BOTH SIDES [3]	REHAB. GENERAL SULLIVAN	WIDEN EAST [2]	WIDEN WEST	WIDEN BOTH SIDES [3]	REMOVE GENERAL SULLIVAN	ARCH BRIDGE	CABLE-STAYED BRIDGE	REMOVE GENERAL SULLIVAN	ALT 1	ALT 2	ALT 3	
WATER QUALITY, AQUATIC LIFE, & FISHERIES	Number of Perennial Stream Crossings		1	5		3	3	3	3	0	0	0		0	0	0		0	0	0		0	0	0		0	0		0	0	0	Impacts to Little Bay not included here, but will be evaluated in DEIS.
	Length of Stream Crossings (Feet)		330	630		410	360	555	660	0	0	0		0	0	0		0	0	0		0	0	0		0	0		0	0	0	
GROUNDWATER QUALITY	Stratified-Drift Aquifer Under New Roadway Area (Acres)		4.9	4.5		4.3	4.4	6.2	7.2	1.2	1.4	1.2		1.2	1.4	1.2		1.2	1.4	1.2		1.2	1.4	1.2		3.1	3.1		19.3	10.7	11.7	Includes all transmissivity categories.
	Number of Well Head Protection Area (WHPA) crossings		0	0		0	0	0	0	0	0	0		0	0	0		0	0	0		0	0	0		0	0		0	0	0	
FLOODPLAINS	Floodplain Impacted (Acres)		0	0		0	0	0	0	0.1	0.1	0.1		0.1	0.1	0.1		0.1	0.1	0.1		0.1	0.1	0.1		0.1	0.1		1.1	1.3	1.3	
WETLANDS	Wetland Impacted (Acres)		10.2	10.9		7.8	10.1	9.4	8.8	0.8	0.5	0.6		0.8	0.5	0.6		0.8	0.5	0.6		0.8	0.5	0.6		0.7	0.7		6.6	4.5	4.6	
VERNAL POOLS	Number of Pools Impacted		0	0		0	0	0	0	0	0	0		0	0	0		0	0	0		0	0	0		0	0		0	0	0	
THREATENED & ENDANGERED SPECIES	Number of Populations Impacted		0	0		0	0	0	0	0	0	0		0	0	0		0	0	0		0	0	0		0	0		0	0	0	Historical location of Prolific Knotweed potentially impacted by all bridge alt's, but none found in August '04.
VISUAL	Impacts to Views from and to the Highway (Qualitative)		H	L		M	M	H	H	M	M	M		M	M	M		M	M	M		M	M	M		H	H		H	M-L	M-L	
ARCHAEOLOGICAL	Number of Sensitive Areas Affected (Native American / Historic)		3	2		3	3	5	6	0	0	0		0	0	0		0	0	0		0	0	0		0	0		7	7	7	Based on Phase IA study. Phase IB and Determination of Eligibility not yet completed.
HISTORICAL	Number of Potentially Eligible or Listed Sites Impacted (Partial Acquisition)		3	3		3	3	3	3	0	0	0		1	1	1		0	0	0		1	1	1		1	1		6	4	4	Historical surveys on-going. Determination of Eligibility not yet completed for most structures.
RIGHT-OF-WAY DISPLACEMENT	Number of Residential Total Property Acquisitions		0	0		1	1	0	0	0	0	0		0	0	0		0	0	0		0	0	0		7	7		14	2	2	
	Number of Business Total Property Acquisitions		1	1		1	1	1	1	0	0	0		0	0	0		0	0	0		0	0	0		0	0		2	1	1	
COMMUNITY SUPPORT	Qualitative		M	L		M	H	H	H	L	H	L	H	L	H	L	M	L	H	L	H	L	H	L	M	M	M	M	L	H	H	
PUBLIC PARKS & RECREATIONAL LAND	Number of Affected 4(f) Properties, other than Historical		0	0		0	0	0	0	1	0	0		1	0	0		1	0	0		1	0	0		0	0		1	1	2	Hilton Park & Bayview Park. No 6(f) properties are located in the study area.
	Area of Affected 4(f) Properties, other than Historical (Acres)		0	0		0	0	0	0	0.5	0	0		0.5	0	0		0.5	0	0		0.5	0	0		0	0		0.9	2.2	2.9	
PETROLEUM & HAZARDOUS MATERIALS	Number of Potentially Contaminated Properties Impacted		5	7		6	6	5	5	0	0	0		0	0	0		0	0	0		0	0	0		0	0		1	2	2	
FARMLANDS	Farmlands Impacted (Acres)		3.3	2.1		1.3	2.8	3.5	4.3	0.9	0	0.4		0.9	0	0.4		0.9	0	0.4		0.9	0	0.4		0.1	0.1		0	0	0	
WILDLIFE HABITAT	High Value Habitat Impacted (Acres)		10.7	12.0		8.4	10.7	9.9	9.8	0.8	0.5	0.6		0.8	0.5	0.6		0.8	0.5	0.6		0.8	0.5	0.6		0.7	0.7		7.5	5.1	5.2	Wetland and early successional habitats.
	Degree of Habitat Fragmentation (Qualitative)		ST	M		M	M	M	M	NI	NI	NI		NI	NI	NI		NI	NI	NI		NI	NI	NI		NI	NI		NI	ST	ST	
MARINE RESOURCES	Affected Benthic Habitat (Acres)																															To be evaluated in the Draft EIS
HYDRODYNAMICS	Change in Tidal Flow Characteristics																															To be evaluated in the Draft EIS
AIR	Microscale CO Exceedances (2025)																															To be evaluated in the Draft EIS
NOISE	Number of Receptors Exceeding FHWA Abatement Criteria																															To be evaluated in the Draft EIS
CONSTRUCTABILITY	Qualitative		D	D		A	A	D	D	A	A	D		A	A	D		A	A	D		A	A	D		A	A		A	A	A	
TRAFFIC OPERATIONS / SYSTEM EFFICIENCY / SAFETY	Qualitative		M	M	L	M	H	H	H	H	H	H		H	H	H		H	H	H		H	H	H		H	H		M	H	H	
LOCAL CONNECTIVITY	Qualitative		L	H		M	M - H	M - H	M - H																				L	M - H	H	
ROADWAY CONSTRUCTION COST	Millions (2004 Dollars) (excluding right of way costs)		$24.8	31		29.4	28.7	29.1	29.6	8.6	8.6	8.4		8.6	8.6	8.4		8.6	8.6	8.4		8.6	8.6	8.4		8.4	8.4		19.4	14.8	15.0	
BRIDGE CONSTRUCTION COST			4.1	11.2		8.3	7.1	16.2	15.9	37.0	37.0	37.0		44.0	44.0	44.0		51.0	51.0	51.0		58.0	58.0	58.0		80.0	82.0		5.3	6.6	8.5	
REHAB. GENERAL SULLIVAN BRIDGE										22.0	22.0	22.0						22.0	22.0	22.0												
REMOVE GENERAL SULLIVAN BRIDGE														5.0	5.0	5.0						5.0	5.0	5.0		5.0	5.0					
PEASE SPUR RAIL COST [4]			5.3	5.8		0.5	0.5	3.6	3.0																							
TOTAL CONSTRUCTION COST			34.2	48.0		38.2	36.3	48.9	48.5	67.6	67.6	67.4		57.6	57.6	57.4		81.6	81.6	81.4		71.6	71.6	71.4		93.4	95.4		24.7	21.4	23.5	

NOTES:

1 Alt. 8 (not shown) is similar to Alt. 7 (single-point interchange layout), except that Alt. 8 utilizes a tight-diamond interchange (i.e for potential lower cost) configuration. This alternative fails from a traffic operations perspective and was not evaluated.

2 The Easterly widening bridge alternative holds the westerly edge of the existing Little Bay bridge with all bridge and approach construction occuring to the east. By inspection this alternative would impact the Hilton Park in Dover and the cove at Bloody Point.

3 The widening to both sides bridge alternative holds the centerline of the existing Little Bay bridge . All bridge and approach construction would occur equally to the east and the west. By inspection this alternative would impact Hilton Park the least.

4 The cost for the relocation of the Pease Rail Spur does not include ballast, track or signal costs. Costs are related to the excavation, embankment, drainage, and the bridge costs related to the establishment of the rail corridor only.

5 Impacts for Alternatives 1, 2 & 3 (Dover) include the impacts of the Connector Road (local access road) at Dover Point. Impacts were calculated assuming a "loop alignment", rather than the "Tee alignment" for the local access road at Hilton Park. (See Figure 4.4-9).

LEGEND	
H = High (very good)	**S** = Straightforward
M = Moderate	**A** = Average Difficulty
L = Low (poor)	**D** = Difficult
ST = Slight	= Not Applicable
NI = No Impact	

PROJECT COST EXAMPLES	LOWEST COST	$M	HIGHEST COST ALTERNATIVE	$M
NEWINGTON SEGMENT	ALT 6 Revised	$34.2	ALT 11	$48.9
BRIDGE SEGMENT	WIDEN & REMOVE GEN. SUL.	$57.6	CABLE-STAYED & REMOVE GEN. SUL.	$95.4
DOVER SEGMENT	ALT 2	$21.4	ALT 1	$24.7
	TOTAL	**$113.2**	**TOTAL**	**$169.0**

Table 5.3-1

Newington - Dover , NH 11238

Four Lane Summary of Roadway and Bridge Impacts / Costs by Alternative

NH Route 16 Spaulding Turnpike Improvements

IMPACTS	UNIT OF MEASUREMENT	NO BUILD	ROADWAY SEGMENT: NEWINGTON [1]							BRIDGE SEGMENTS (INCLUDING APPROACHES): WIDEN LITTLE BAY BRIDGE								REPLACE LITTLE BAY BRIDGE											SEGMENT: DOVER [5]			COMMENTS
										REHABILITATE GENERAL SULLIVAN BRIDGE FOR USE AS MULTI-USE PATHWAY				INCLUDES NEW MULTI-USE PATHWAY (REMOVE GENERAL SULLIVAN BRIDGE)				REPLACE ONLINE REHABILITATE GENERAL SULLIVAN BRIDGE FOR USE AS MULTI-USE PATHWAY				REPLACE ON-LINE (REMOVE GENERAL SULLIVAN BRIDGE w/ NEW MULTI-USE PATHWAY)				REPLACE OFF-LINE (WEST)						
			ALT 6 Revised	ALT 7	ALT 8 [1]	ALT 9	ALT 10	ALT 11	ALT 12	WIDEN EAST [2]	WIDEN WEST	WIDEN BOTH SIDES [3]	REHAB. GENERAL SULLIVAN	WIDEN EAST [2]	WIDEN WEST	WIDEN BOTH SIDES [3]	REMOVE GENERAL SULLIVAN	WIDEN EAST [2]	WIDEN WEST	WIDEN BOTH SIDES [3]	REHAB. GENERAL SULLIVAN	WIDEN EAST [2]	WIDEN WEST	WIDEN BOTH SIDES [3]	REMOVE GENERAL SULLIVAN	ARCH BRIDGE	CABLE-STAYED BRIDGE	REMOVE GENERAL SULLIVAN	ALT 1	ALT 2	ALT 3	
WATER QUALITY, AQUATIC LIFE, & FISHERIES	Number of Perennial Stream Crossings		1	5		3	3	3	3	0	0	0		0	0	0		0	0	0		0	0	0		0	0		0	0	0	Impacts to Little Bay not included here, but will be evaluated in DEIS.
	Length of Stream Crossings (Feet)		330	630		410	360	555	660	0	0	0		0	0	0		0	0	0		0	0	0		0	0		0	0	0	
GROUNDWATER QUALITY	Stratified-Drift Aquifer Under New Roadway Area (Acres)		4.9	4.5		4.3	4.4	6.2	7.2	1.8	2.1	1.9		1.8	2.1	1.9		1.8	2.1	1.9		1.8	2.1	1.9		3.7	3.7		20.3	11.7	12.7	Includes all transmissivity categories.
	Number of Well Head Protection Area (WHPA) crossings		0	0		0	0	0	0	0	0	0		0	0	0		0	0	0		0	0	0		0	0		0	0	0	
FLOODPLAINS	Floodplain Impacted (Acres)		0.00	0.00		0.00	0.00	0.00	0.00	0.1	0.1	0.1		0.1	0.1	0.1		0.1	0.1	0.1		0.1	0.1	0.1		0.1	0.1		1.1	1.3	1.3	
WETLANDS	Wetland Impacted (Acres)		10.5	10.9		8.1	10.4	9.7	9.1	0.9	0.6	0.8		0.9	0.6	0.8		0.9	0.6	0.8		0.9	0.6	0.8		0.7	0.7		7.0	4.9	5.1	
VERNAL POOLS	Number of Pools Impacted		0	0		0	0	0	0	0	0	0		0	0	0		0	0	0		0	0	0		0	0		0	0	0	
THREATENED & ENDANGERED SPECIES	Number of Populations Impacted		0	0		0	0	0	0	1	1	1		1	1	1		1	1	1		1	1	1		1	1		0	0	0	Historical location of Prolific Knotweed potentially impacted by all bridge alt's, but none found in August '04.
VISUAL	Impacts to Views from and to the Highway (Qualitative)		H	L		M	M	H	H	M	M	M		M	M	M		M	M	M		M	M	M		H	H		H	M	M	
ARCHEOLOGICAL	Number of Sensitive Areas Affected (Native American / Historic)		3	2		3	3	5	6	0	0	0		0	0	0		0	0	0		0	0	0		0	0		7	7	7	Based on Phase IA study. Phase IB and Determination of Eligibility not yet completed.
HISTORICAL	Number of Potentially Eligible or Listed Sites Impacted (Partial Acquisition)		3	3		3	3	3	3	0	0	0		1	1	1		0	0	0		1	1	1		1	1		6	4	4	Historical surveys on-going. Determination of Eligibility not yet completed for most structures.
RIGHT-OF-WAY DISPLACEMENT	Number of Residential Total Property Acquisitions		0	0		1	1	0	0	0	0	0		0	0	0		0	0	0		0	0	0		7	7		14	2	2	
	Number of Business Total Property Acquisitions		1	1		1	1	1	1	0	0	0		0	0	0		0	0	0		0	0	0		0	0		2	1	1	
COMMUNITY SUPPORT	Qualitative		M	L		M	H	H	H	L	H	L	H	L	H	L	M	L	H	L	H	L	H	L	M	M	M	M	L	H	H	
PUBLIC PARKS & RECREATIONAL LAND	Number of Affected 4(f) Properties, other than Historical		0	0		0	0	0	0	1	0	1		1	0	1		1	0	1		1	0	1		0	0		1	1	2	Hilton Park & Bayview Park. No 6(f) properties are located in the study area.
	Area of Affected 4(f) Properties, other than Historical (Acres)		0	0		0	0	0	0	0.7	0	0.1		0.7	0	0.1		0.7	0	0.1		0.7	0	0.1		0	0		0.9	2.2	2.9	
PETROLEUM & HAZARDOUS MATERIALS	Number of Potentially Contaminated Properties Impacted		5	7		6	6	5	5	0	0	0		0	0	0		0	0	0		0	0	0		0	0		1	2	2	
FARMLANDS	Farmlands Impacted (Acres)		3.3	2.1		1.3	2.8	3.5	4.3	1	0	0.6		1	0	0.6		1	0	0.6		1	0	0.6		0.1	0.1		0	0	0	
WILDLIFE HABITAT	High Value Habitat Impacted (Acres)		11.0	12.0		8.7	11.0	10.2	10.1	0.9	0.6	0.8		0.9	0.6	0.8		0.9	0.6	0.8		0.9	0.6	0.8		0.7	0.7		7.9	5.5	5.6	Wetland and early successional habitats.
	Degree of Habitat Fragmentation (Qualitative)		ST	M		M	M	M	M	NI	NI	NI		NI	NI	NI		NI	NI	NI		NI	NI	NI		NI	NI		NI	ST	ST	
MARINE RESOURCES	Affected Benthic Habitat (Acres)																															To be evaluated in the Draft EIS
HYDRODYNAMICS	Change in Tidal Flow Characteristics																															To be evaluated in the Draft EIS
AIR	Microscale CO Exceedances (2025)																															To be evaluated in the Draft EIS
NOISE	Number of Receptors Exceeding FHWA Abatement Criteria																															To be evaluated in the Draft EIS
CONSTRUCTABILITY	Qualitative		D	D		A	A	D	D	A	A	D		A	A	D		A	A	D		A	A	D		A	A		A	A	A	
TRAFFIC OPERATIONS / SYSTEM EFFICIENCY / SAFETY	Qualitative		M	M	L	M	H	H	H	H	H	H		H	H	H		H	H	H		H	H	H		H	H		M	H	H	
LOCAL CONNECTIVITY	Qualitative		L	H		M	M-H	M-H	M-H																				L	M - H	H	
ROADWAY CONSTRUCTION COST	Millions (2004 Dollars) (excluding right of way costs)		25.4	31.2		29.4	29.3	30.7	30.2	9.7	9.7	9.3		9.7	9.7	9.3		9.7	9.7	9.3		9.7	9.7	9.3		9.7	9.7		19.7	15.2	15.3	
BRIDGE CONSTRUCTION COST			4.3	11.2		9.2	7.7	16.2	15.9	46.0	46.0	46.0		52.0	52.0	52.0		60.0	60.0	60.0		67.0	67.0	67.0		92.0	95.0		5.3	7.1	9.0	
REHAB. GENERAL SULLIVAN BRIDGE										22.0	22.0	22.0						22.0	22.0	22.0												
REMOVE GENERAL SULLIVAN BRIDGE														5.0	5.0	5.0						5.0	5.0	5.0		5.0	5.0					
PEASE SPUR RAIL COST [4]			5.6	5.8		0.6	0.6	3.6	3.0																							
TOTAL CONSTRUCTION COST			35.3	48.2		39.2	37.6	50.5	49.1	77.7	77.7	77.3		66.7	66.7	66.3		91.7	91.7	91.3		81.7	81.7	81.3		106.7	109.7		25.0	22.3	24.3	

NOTES:

1 Alt. 8 (not shown) is similar to Alt. 7 (single-point interchange layout), except that Alt. 8 utilizes a tight-diamond interchange (i.e for potential lower cost) configuration. This alternative fails from a traffic operations perspective and was not evaluated.

2 The Easterly widening bridge alternative holds the westerly edge of the existing Little Bay bridge with all bridge and approach construction occuring to the east. By inspection this alternative would impact the Hilton Park in Dover and the cove at Bloody Point.

3 The widening to both sides bridge alternative holds the centerline of the existing Little Bay bridge . All bridge and approach construction would occur equally to the east and the west. By inspection this alternative would impact Hilton Park the least.

4 The cost for the relocation of the Pease Rail Spur does not include ballast, track or signal costs. Costs are related to the excavation, embankment, drainage, and the bridge costs related to the establishment of the rail corridor only.

5 Impacts for Alternatives 1, 2 & 3 (Dover) include the impacts of the Connector Road (local access road) at Dover Point. Impacts were calculated assuming a "loop alignment", rather than the "Tee alignment" for the local access road at Hilton Park. (See Figure 4.4-9).

LEGEND	
H = High (very good)	S = Straightforward
M = Moderate	A = Average Difficulty
L = Low (poor)	D = Difficult
ST = Slight	= Not Applicable
NI = No Impact	

PROJECT COST EXAMPLES	FOUR LANE - LOWEST COST	$M	FOUR LANE - HIGHEST COST	$M
NEWINGTON SEGMENT	ALT 6 Revised	$35.3	ALT 11	$50.5
BRIDGE SEGMENT	WIDEN & REMOVE GEN. SUL.	$66.7	CABLE-STAYED & REMOVE GEN. SUL.	$109.7
DOVER SEGMENT	ALT 2	$22.3	ALT 1	$25.0
	TOTAL	**$124.3**	**TOTAL**	**$185.2**

Table 5.3-2

Most impact calculations were completed within a Computer Aided Design and Drafting (CADD) system by overlaying the alternative footprint onto mapped environmental resources and properties, and counting or calculating impacts.

In other cases, impacts were assessed using a qualitative scale. A qualitative approach was used in cases where estimation of actual impacts was not possible due to the preliminary nature of the alternative layouts, or because additional data or modeling, deemed beyond the scope of the environmental screening, would have been necessary.

Certain resources, such as air quality, noise impacts, socio-economic and secondary effects were not assessed during this initial screening. In these cases, no meaningful quantitative or qualitative evaluation could be made since these analyses rely on a more complete understanding of the conceptual engineering and traffic operations resulting from the project. Similarly, as discussed in more detail below, impacts to certain resources associated with the Little Bay (*e.g.,* benthic habitat) could not be determined due to the fact that no engineering of new or expanded bridge piers has been completed to date. Note that existing conditions for these resources were reported in the March 2004 Scoping Report and a full analysis of each resource will be contained in the Draft EIS.

The results of the Environmental Screening of project alternatives are discussed below. Some information on the resources present in the study area and the methodologies used to develop the screening have been included, while more detailed information on these topics is contained within the project Scoping Report issued in March 2004.

5.3.1.2 Surface Waters

Existing Conditions

The study area contains five perennial freshwater streams (Pickering Brook, Paul Brook, Flagstone Brook, Railway Brook, and an unnamed perennial stream), as well as two small unnamed ponds, all of which are located within the Newington portion of the study area. No perennial streams are located within the Dover portion of the study area.

Perhaps the most notable feature of the study area, however, is the Great Bay estuary, a tidally influenced waterway consisting of the Great Bay, Little Bay, their tributaries and the Piscataqua River. The study area includes large portions of Little Bay and the Piscataqua River, as well as portions of the Bellamy River. There are no rivers located in the study area that are designated under the National Wild and Scenic Rivers Program or the NH Rivers Management and Protection Program. However, the National Marine Fisheries Service reports that the area is considered Essential Fish Habitat for a number of species. (See the March 2004 Scoping Report for more information.)

Impacts

Impacts to marine resources will result from expansion of existing bridge piers or the construction of new piers, depending on the alternative. These impacts are potentially both direct (*i.e.,* filling of benthic habitat) and indirect (by altering local currents). However, since preliminary bridge engineering has not specified the potential footprint of new or expanded piers, no quantitative assessment of impacts to marine resources can be made at this time. Presumably, construction of a new bridge off-line, with entirely new piers, would have a greater impact than widening/rehabilitation of the Little Bay Bridges. A portion of these impacts could be offset if the existing Little Bay Bridge piers (or the General Sullivan Bridge piers) were removed, although this would have to be balanced against the potential disruption or impact on resources that exist there today.

Impacts to surface water may result from increased stormwater runoff and from the direct impact to benthic habitat due to culvert extensions. To estimate the potential effects on surface waters for the analysis of alternatives, the number and length of perennial (freshwater) stream crossings for each alternative have been estimated. These data are reported in the Summary of Impacts and Costs (Tables 5.3-1 and 5.3-2) for both the 3-lane and 4-lane Alternatives, respectively.

The project will not result in impacts to perennial streams in the Dover or Bridge Segments, since no such streams are located in these areas (aside from the Bellamy River at the western edge of the study area which will not be directly impacted).

In Newington, alternatives under either the 3-lane or 4-lane option are expected to impact between 330 and 660 linear feet of streambed. Of the six alternatives evaluated, Alternative 6 (Revised) has the least impact whether three or four lanes, with just a single expansion of the crossing of Pickering Brook at the mainline Turnpike. Alternative 7 has a relatively large impact under either the 3-lane or 4-lane option with a total of five new or expanded stream crossings, including a new crossing of Railway Brook near Arboretum Drive. All other alternatives (Alternatives 9 through 12), whether three lanes or four lanes, have a total of three new or expanded stream crossings, but they vary in the amount of streambed habitat impacted. Note that Alternative 12 proposes a new 2-lane crossing of Railway Brook to provide a connection between the Pease Tradeport and Woodbury Avenue/Patterson Lane that may impact up to 80 linear feet of this stream resource.

5.3.1.3 Floodplains

Existing Conditions

To determine floodplain elevations in the study area, Flood Insurance Study (FIS) and Flood Insurance Rate Map (FIRM) data were collected for the cities of Portsmouth and Dover and the towns of Durham and Exeter, as these municipalities have boundaries along the Piscataqua River, Bellamy River, and Little Bay. Based on these data Base

Flood Elevations of tidal waters within the study area are generally between 7 and 9 feet above mean sea level (National Geodectic Vertical Datum [NGVD]of 1929).

Note that these areas are entirely associated with the tidal portions of the study area. Within Dover, the floodplain is restricted to the tidal portions of the Bellamy River, Little Bay, and the Piscataqua River. A relatively substantial floodplain is located at Bayberry Park in the northwestern portion of the study area (near Royals Cove). In Newington, the floodplain is associated with the tidal portions of the Little Bay and the Piscataqua River. No mapped floodplain is associated with the freshwater streams located in Newington.

Impacts

The project could displace flood storage by the construction of additional highway infrastructure. The project also might increase runoff due to additional highway pavement area, and could decrease the capacity of new or existing culverts and bridges to convey increased flow (if any). These latter two impacts can typically be avoided through careful design of stormwater treatment facilities and hydraulic analysis of new or reconstructed culvert/bridge structures.

To estimate relative impacts to flood storage, the area of new roadway below elevation 7 to 9 in Dover and elevation 6 in Newington was calculated. The footprint of each alternative was overlaid onto this floodplain boundary and the area of floodplain impact calculated. Since grading was not completed for any alternative, a volumetric analysis was not possible during this initial alternatives screening (but will be conducted and presented in the Draft EIS).

There are no impacts to floodplains within the Newington roadway segment, since no such resources exist within this area.

Estimated impacts to 100-year floodplain for the Dover roadway segment range from 1.1 acres for Alternative 1 to 1.3 acres for Alternatives 2 and 3, under both the 3-lane and 4-lane options. These impacts are primarily associated with small areas of floodplain near Pomeroy Cove and at the reconstructed approach to the Scammell Bridge.

Less substantial impacts to floodplain will occur in the Bridge segment, associated with the Little Bay.

The estimates described in this report include just the portion of the floodplain impacted by the highway infrastructure, and do not include the area impacted by the new or expanded bridge piers. The potential effects to the hydrodynamics of the Little Bay will be fully explored in the EIS by way of a three-dimensional hydrodynamic model (FESWMS and/or RMA II, in combination with the Surface Water Modeling System developed by Brigham Young University). These models

will evaluate the effect of the project on tidal currents, as well as the potential effect to tidal heights in the surrounding areas.

5.3.1.4 Groundwater Resources

Existing Conditions

Notable within the study area is a large glacial stratified-drift aquifer that exists under the entire northern portion of the study area in Dover. The majority of this aquifer is mapped with a transmissivity value of 1,000 to 2,000 sq ft/day, relatively low for a stratified drift formation. Smaller portions of this aquifer directly north of Pomeroy Cove have higher transmissivity values, with potentials of 2,000 to 8,000 sq ft/per day. A second stratified drift aquifer also occurs along the western side of the Newington portion of the study area (Pease Tradeport) and is mapped with a relatively low transmissivity value of 1 to 1,000 sq ft/day. Groundwater within the study area is currently classified as GA2, the default classification for areas of known stratified drift deposits.

According to a review of existing geological mapping and consultations with the NHDES, no high yield bedrock aquifers or community wells occur within the study area. Rather, most of the study area is served by municipal water supplies in Newington and Dover. Two private community water wells occur in Dover within the northeast portion of the study area. And, a Phase I Wellhead Protection Area occurs in the southwestern portion of the study area in Newington associated with a well just beyond the study area on the Pease Tradeport.

Impacts

None of the roadway alternatives will require work within any of the public or private wellhead protection areas located within the study area, so direct effects to existing water supplies are expected to be negligible.

However, new impervious surfaces within the stratified drift aquifer areas have the potential to affect the future availability of groundwater in the vicinity. The precise effect on the aquifer cannot be precisely determined based on available information since the movement of water in the aquifer is fairly complex. However, some indicator of the relative potential effect among the various alternatives was estimated by measuring the amount of new impervious surface over stratified drift deposits. These impacts were measured by overlaying the footprint of each alternative onto baseline aquifer mapping. For purposes of this analysis, no differentiation among transmissivity zones was made.

Within Dover, Alternative 1 would create an estimated 19.3 or 20.3 acres of new impervious surface above the Dover Point aquifer for the three lane and four lane, respectively. This is a substantially larger impact than Dover Alternatives 2 and 3,

which would create 10.7 to 11.7 and 11.7 to 12.7 acres of new impervious surface, respectively.

The Newington alternatives are expected to have less substantial impacts to stratified drift deposits than the Dover segment. Alternatives 6 Revised through 10 all impact less than 5 acres under the 3-lane or 4-lane option. Alternatives 11 and 12 have relatively greater impact under the 3-lane and 4-lane options because they concentrate new roadway infrastructure near Arboretum Drive, in the vicinity of Railway Brook, above an area mapped as stratified drift. Alternative 11 is estimated to impact as much as 6.2 acres of stratified drift deposits, while Alternative 12 may impact as much as 7.2 acres, under either the 3-lane or 4-lane option.

Impacts to stratified drift deposits will also occur in the Bridge Segment. In this area, no distinction exists among the on-line rehabilitation or replacement options (approximately 1.4 or 2.1 acres affected for the 3-lane and 4-lane options, respectively, on the Dover side of the segment). However, the off-line replacement of the Little Bay Bridge is expected to impact approximately 3.1 or 3.7 acres of aquifer depending on whether it is the 3-lane or 4-lane option.

5.3.1.5 Farmlands

Existing Conditions

The Natural Resource Conservation Service (NRCS) Soil Survey of Strafford County (Vieira and Bond 1973) and Rockingham County (Kelsea and Gove 1994) were used to identify soil types within the study area. The NRCS field offices in Dover and Brentwood provided current lists of Prime, Statewide, and Locally Important Farmland soils. These soil units were then identified using GIS digital soil mapping (digitized from the above-referenced soil surveys) to develop a base map of important farmland soils. Farmland within the Dover-Rochester Urbanized Area as well as other areas within the study area with a density of 30 structures per 40-acre area was excluded per federal guidance. A review of aerial photographs and field verification was also conducted to determine the presence of active farmlands within the study area. The resulting data were then overlaid onto alternative footprints to calculate the amount of farmland soils impacted.

No important farmland soils are located within the study area in Dover, although two areas identified as being in agricultural use are located to the east of Dover Point Road in the northern-most portion of the study area.

Several areas of farmland soils are mapped in Newington. These areas include land to the north and south of Nimble Hill Road, portions of which remain in or are available to agricultural use. Additionally, substantial portions of Bloody Point and the land north of Patterson Lane to the east of the Turnpike are mapped as prime farmland. Some of these areas, although not excluded as urbanized area, consist primarily of industrial, retail, and residential development, and forested upland and

wetland habitats. Some areas designated by NRCS as farmland based on soil type include waterways and vegetated wetlands, and do not necessarily reflect those areas conducive to agricultural production.

Impacts

Impacts to farmland result from the direct filling of these soils, which can eliminate areas of high potential productivity. As noted above, while much of the study area is urbanized, relatively substantial portions of important farmland soils remain.

There are no impacts to farmland soils in Dover, and two identified agricultural areas to the east of Dover Point Road will not be directly impacted by any alternative.

Estimated impacts to farmland soils in the Newington segment range from about 1.3 acres to about 4.3 acres, under both the 3-lane and 4-lane options. Of these, Alternatives 10, 11, and 12 tend to have slightly greater impacts (2.8 to 4.3 acres) than Alternatives 6 Revised, 7, and 9 (1.3 to 3.3 acres in total), under both the 3-lane and 4-lane options.

No substantial impacts to farmland soils are expected within the Bridge Segment. Off-line replacement alternatives have the potential for some small impact (much less than one acre), but the soils in question are not currently active farmland.

As part of the DEIS analysis, the impacts on important farmland soils will be formally evaluated as required by the Farmland Protection Policy Act (FPPA) of 1984. This process involves comparison of project alternatives relative to their effect on converting potential or existing farmlands to non-agricultural use.

5.3.1.6 Wetlands & Vernal Pools

Existing Conditions

Wetland resources within the study area were identified through a combination of aerial photo interpretation and field verification. The study site was flown in the summer of 2002 to produce 1:2400 scale full-color digital orthophotography. National Wetland Inventory (NWI) wetland layers obtained from New Hampshire's GRANIT Geographic Information System (GIS) were first plotted onto the orthophotograph. Environmental scientists conducted extensive field investigations during the months of June, July, and August of 2003. Limits of all wetland resources identified during the Phase I photo interpretation effort were verified for accuracy and mapping was adjusted in the field, as appropriate. The wetland classification type for each wetland identified was field-verified based on Cowardin *et al.,* 1979. Additionally, the locations of potential vernal pools were identified during the 2003 field work and additional field investigation performed to confirm vernal pools was conducted early in the 2004 field season.

Wetlands within the study area include Palustrine and Estuarine systems, as detailed in the March 2004 Scoping Report and summarized below:

Palustrine Wetlands

Palustrine (freshwater) system wetlands include all non-tidal wetlands dominated by trees, shrubs, persistent emergent, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 parts per thousand.

Forested Wetlands

Deciduous forested swamps within the study area occur in both Dover and Newington. In Newington, the majority of forested swamps are found west of the Spaulding Turnpike since that area is generally less developed. Relatively expansive forested wetlands are located between Exit 1 and Exit 3 near and within the Pease Tradeport and west of Tricky's Cove. Smaller remnant forested wetlands also occur east of the highway, amongst commercial development near Gosling Road, Woodbury Avenue, and River Road.

In Dover, palustrine forested wetlands occur within the Exit 6 Interchange and to the east of Dover Point Road amongst residential areas. Another larger forested system occurs west of the Spaulding Turnpike near Bayview Park north of Spur Road. Portions of this system are dominated by coniferous species.

A good example of a mixed deciduous/coniferous forested swamp within the study area occurs in Newington near Exit 1, north of Pease Boulevard. Smaller pockets occur within other larger deciduous swamps previously described. In Dover, a large area of mixed deciduous coniferous forested swamp is located north of Exit 6 within Bayview Park.

Scrub-Shrub Wetlands

Noteworthy are the extensive scrub-shrub thickets associated with the channelized Railway Brook, a tributary to Pickering Brook, extending from the Pease Tradeport and eventually discharging as Flagstone Brook into Tricky's Cove in Newington. The scrub-shrub wetland east of River Road and south of Sprague Energy has been altered by vegetation clearing activities resulting in patchy areas of early successional and non-native species. Other scrub-shrub swamps are located along utility easements located west of the Spaulding Turnpike between Exits 2 and 4. Additional smaller areas of scrub-shrub swamp collect highway drainage along the right-of-way or are marginal between forested wetlands and areas of emergent wetland. Other than along some of the Turnpike drainage features, few substantial areas of scrub-shrub wetlands occur in Dover.

Emergent Wetlands

Examples of freshwater emergent marsh wetlands located in Newington include those found in numerous roadside drainage areas immediately adjacent to both sides of the Spaulding Turnpike. Larger areas of marsh wetland are also found associated with the Southern New England Calcareous Seepage Swamp (a circumneutral[18] forested deciduous swamp) located in the northwest quadrant of Exit 1, north of Pease Boulevard. In Dover, freshwater emergent marshes are less numerous and located in similar landscape positions adjacent to the highway.

The best example of emergent wet-meadow wetlands within the Newington segment of the study area can be found associated with areas of scrub-shrub wetland along the utility easements, and on the former drive-in theatre property west of the Turnpike between Exit 3 and Exit 4. Other locations of wet meadow wetlands include areas near Paul Brook located to the east of Woodbury Avenue. In Dover, wet meadows can be found in the vicinity of the Exit 6 Interchange.

Vernal Pools

Vernal pools can be components of the forested, scrub-shrub, or emergent wetland systems described above. Pools are temporary bodies of water providing essential breeding habitat for certain amphibians and invertebrates and which do not support fish. They are far less common on the landscape than other wetland elements, and can be home to state-protected species. Vernal pool indicator species in NH include fairy shrimp *(Anostraca eubranchipus)*, wood frogs *(Rana sylvatica),* and any of the mole salamanders *(Ambystoma spp.).*

A total of eight potential vernal pools were preliminarily identified during 2003 field work. Additional survey was performed at the end of the spring 2004 breeding season to search for positive evidence of breeding by indicator species. Of the eight potential pools, only two areas were confirmed to meet the criteria for designation as vernal pools.

A relatively large and diverse complex of vernal pools was found adjacent to the Guilford Railroad Newington Branch approximately 1,600 feet north of Patterson Lane along the inactive railroad corridor. A second pool complex was identified west of Arboretum Drive on the Pease Tradeport within a large red maple *(Acer rubrum)* pit and mound swamp. These pools are outside of the proposed Turnpike upgrade, but could be of concern if the railroad corridor is to be upgraded at a later date.

Estuarine Wetlands

The estuarine system consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to open ocean, and in which ocean water is at least occasionally diluted by

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[18] Circumneutral is defined as having a pH of around 7.

freshwater runoff from the land. Estuarine, intertidal wetlands within the study area consist of fringing salt marsh habitats, some with hydrologic constrictions resulting from roadway and railway fragmentation and undersized culverts. Examples of estuarine tidally-influenced wetlands in Newington include those found along portions of the Piscataqua River, especially near the former outlet of Pickering Brook where tidal gates are located on industrial property east of River Road. (Much of Pickering Brook's flow appears to now be diverted northward to Tricky's Cove via Flagstone Brook, a constructed channel.) The lower reaches of Paul Brook also contain tidally-influenced marshes. In Dover, intertidal wetlands include the area around Pomeroy Cove, Hilton Park, and near the Scammell Bridge in the northwest portion of the project study area.

Impacts

Wetland impacts in the Newington roadway segment range from approximately 7.8 acres to as much as 10.9 acres for the alternatives with the 3-lane option, and 8.1 to 10.9 acres with the 4-lane option. A substantial portion of these impacts result from the realignment of the Turnpike within the median area near Exit 4N. The bulk of the affected wetlands are classified as palustrine scrub-shrub and emergent systems, although they also have a forested component. The functional values of these wetlands are currently affected by their position between the northbound and southbound highway barrels. Note that all alternatives affect these wetlands to the same degree, since all alternatives share a similar cross-section and alignment in this location.

The variation among the Newington alternatives is largely a factor of the different layouts for improved east-west local connections between the commercial/residential and industrial areas of Woodbury Avenue/Shattuck Way/Patterson Lane and the Pease Tradeport and Nimble Hill Road. Wetlands in this vicinity are largely seasonally flooded to seasonally saturated forested systems associated with Railway Brook, and wet meadow and scrub-shrub wetlands within an overhead utility corridor. The loop ramp configuration of Alternatives 9 and 12 tend to have less impact to these wetlands than other interchange layouts.

None of the Newington alternatives would result in impacts to the Southern New England Calcareous Seepage Swamp (circumneutral swamp) in the northwest quadrant of the Exit 1 area or the Southern New England Acidic Seepage Swamp to the south and west of Arboretum Drive on the Tradeport property located along western limits of the study area. Similarly, none of the alternatives directly impacts either of the two vernal pools identified in the study area.

Within the Dover segment, all alternatives would result in impacts to the freshwater forested wetland in the southwest quadrant of the Exit 6 Interchange – though completely surrounded by ramps, the Turnpike and the overpass – it is one of the largest freshwater systems identified in the study area. These impacts result from reconfigured and new highway infrastructure needed to connect US Route 4 and

Dover Point Road to the southbound barrel of the Turnpike. Although noteworthy, the actual impacts to this system will remain at its western edge, allowing the majority of the system to remain intact.

All Dover alternatives also impact a forested wetland located between the southern end of Dover Point Road and the Exit 6 northbound off ramp. This area is already somewhat degraded by the urbanized adjacent land use, but would be substantially filled by Alternatives 1 through 3.

Note that a relatively substantial difference in impacts exists between Dover Alternative 1 (6.6 acres and 7.0 acres depending on whether three lanes or four lanes) as compared to Alternatives 2 and 3 (4.5 and 4.6 acres with three lanes and 4.9 and 5.1 with four lanes, respectively). This difference is due to the fact that Alternative 1 proposes to construct a new local roadway connecting Dover Point Road to Hilton Park. This roadway would be located parallel to and east of a widened Turnpike and would substantially impact several palustrine forested wetlands near Wentworth Terrace and Dover Point Road - as well as encroaching substantially on Pomeroy Cove.

5.3.1.7 Wildlife Habitat

Existing Conditions

The occurrence of wildlife species and habitat use in the study area are heavily influenced by the geographic location of the habitats and surrounding land uses. The study area is located in coastal New Hampshire with the large Great Bay estuary, including the Great Bay National Wildlife Refuge, to the west and the Piscataqua River to the east. Extensive commercial and industrial land uses along the east side of the Turnpike in the Newington portion of the study area, and residential development, as well as the Turnpike itself, on Dover Point, have fragmented and isolated most of the natural habitats in the study area. The existing Spalding Turnpike already poses a formidable barrier to most east to west wildlife movement with the possible exception of birds.

On Dover Point there is very little habitat or occurrence of a wildlife corridor to attract mammals, amphibians or reptiles to cross the Turnpike overland, although movement in and out of the freshwater wetland habitat (block #8) within the Exit 6 Interchange median to Bayview Park and the Bellamy River corridor is presumed to occur. There are no stream corridors on the Dover Point side.

On the Newington side, most of the landscape east of the Spaulding Turnpike is developed. Much of the remaining natural habitat, with one or two exceptions, is severely fragmented. Pickering Brook is the only potentially important wildlife corridor that physically crosses the Turnpike. This brook and the riparian habitats along it no doubt once provided a very important overland-link from inland habitats to the west and the waters of the Piscataqua River to the east. Other corridors that

still remain of some importance flow primarily parallel to the Turnpike, including Railway Brook and Flagstone Brook.

A relatively intact block of habitat in Newington, approximately 240 acres in size including Pease Tradeport conservation lands, exists in the area between Arboretum Drive and Nimble Hill Road to the west of the Turnpike. This area is referred to as "block #3."

Impacts

Impacts to wildlife habitat were assessed in two ways, as described below:

Habitat Fragmentation

Each alternative alignment was visually examined to evaluate the relative degree of habitat fragmentation that would occur. In particular, the alignments were compared as to whether they fragmented relatively large contiguous blocks of similar habitat (≥5 acres) or severed travel corridors connecting these blocks. All forested blocks and wetlands were examined, as well as open habitats such as old fields, orchards, and pastures. A habitat block that was totally encircled by new roadways, even though not severed, was downgraded. Scores for this criterion were evaluated by inspection with a qualitative ranking from No Impact (no change in the baseline or existing conditions) to High (severe impacts).

Relative to the potential fragmentation of habitats, the degree of fragmentation in the Newington end by Alternative 6 Revised was rated as Slight, while Alternatives 7 and 9 through 12 were rated as Moderate for both the 3 and 4-lane options (Tables 5.3-1 and 5.3-2). Although the differences among the alternatives is small, the footprint of Alternative 6 Revised concentrates fragmentation by placing the railroad spur and the connector roadway in close proximity to each other. Instead of fragmenting habitat block #3 in two places like the other alternatives, Alternative 6 Revised essentially splits block #3 with only one corridor (containing both the new roadway and railroad spur). Block #3 is primarily composed of softwood forest.

At the Dover end, the fragmentation effect of both Alternatives 2 and 3 is rated as Slight, while Alternative 1 has No Impact for either the 3 or 4-lane option. Alternatives 2 and 3 both affect habitat block #8 that is located in the median between the southbound ramp from US 4 and the Spaulding Turnpike. In comparison, the new roadway for Alternative 1 remains primarily on existing alignment and does not fragment this habitat block, comprised mainly of mixed upland forest and forested wetland, under either the 3 or 4-lane option.

There are no impacts related to habitat fragmentation with any of the Bridge segment alternatives.

Loss of High Value Wildlife Habitat

This criterion was operationally defined as the relative loss of any freshwater wetland habitat types (all were presumed important for wildlife for this macro-level analysis) and any early-successional stages, such as grasslands (including pastures), old fields, orchards, and cultivated fields. In addition, any habitat for a threatened or endangered species, specifically the grasshopper sparrow (*Ammodramus savannarumi*) and Henslow's sparrow (*Ammodramus henslowii*), was considered important. The grasshopper sparrow, which prefers hay fields and weedy fallow fields (New England Wildlife: Habitat, Natural History, and Distribution by DeGraaf and Rudis, 1986), has been reported to occur just outside the western portion of the study area in Newington. The Henslow's sparrow prefers similar habitats, especially neglected weedy fields – commonly with broomsedge, wet meadows and salt marsh edges (DeGraaf and Rudis 1986). There is a recorded occurrence for Henslow sparrows along Fox Point Road in Newington.

The unit of measurement for scoring this criterion was the actual number of acres potentially impacted by each project alternative. The footprint of each alternative was overlaid on a base map showing wetlands and open or early successional stage habitats. The number of acres of these high value wildlife habitat affected by each alternative is shown in Tables 5.3-1 and 5.3-2.

In the Newington roadway segment, Alternative 6 Revised affects only about one acre less than Alternative 7 under either the 3 or 4-lane option. Similarly, Alternatives 9 through 12 affect from 1-4 fewer high value acres than Alternative 7 under either the 3 or 4-lane option. In fact, 90 percent or more of the affected high value acreages is wetlands (see Wetlands line in the Summary of Impacts and Costs (Tables 5.3-1 and 5.3-2). In the Dover roadway segment, Alternatives 2 and 3 affect nearly identical amounts of high value habitat and about 2 acres less than Alternative 1 under either the 3 or 4-lane option. As on the Newington end, wetland habitats account for approximately 90% of the affected acreages.

Impacts of the Bridge segment alternatives on high value habitats are all very similar and total less than 1 acre for either the 3 or 4- lane option (Tables 5.3-1 and 5.3-2).

5.3.1.8 Threatened and Endangered Species

Existing Conditions

Rare plant species and natural plant communities within the study area include the prolific knotweed *(Polygonum prolificum)* in the vicinity of Hilton Park (within an area potentially affected by bridge construction), small spike-rush (*Eleocharis parvula*) off Bay View Road, and the Southern New England Calcareous Seepage Swamp and bulbous bitter-cress *(Cardamine bulbosa)* to the northwest of Exit 1. Rare wildlife species within the study area may include the grasshopper and Henslow's sparrow,

bald eagle *(Haliaeetus leucocephalus*) and the New England cottontail (S*ylvilagus tansitionalis*).

As noted in the March 2004 Scoping Report, the population of the prolific knotweed at Hilton Park is known from a relatively old record (1955) and may be extirpated from the vicinity. Additional field work during the late summer of 2004 failed to confirm any population of the prolific knotweed, which historically had been identified in an area that would be impacted by the current project. The final survey work for this population was performed during August 2004, the period when the plant typically flowers and is thus most readily identified.

Impacts

The recorded location for small spike-rush at Royals Cove in Dover would not be impacted by any of the alternatives. Due to the very preliminary information on the occurrence of rare wildlife habitat, no impact assessment was undertaken for the grasshopper and Henslow's sparrow, bald eagle, or New England cottontail.

All the bridge alternatives have the potential to impact the historical location for prolific knotweed in the vicinity of Hilton Park. However, as mentioned above, none was found there in August 2004. While mitigation of impacts to rare plant populations can be difficult, transplantation or creation of new habitat is often possible when populations are found.

5.3.1.9 Community Environment

Existing Conditions

Potential impacts of USDOT funded projects must be considered during the EIS process. Specifically, impacts to publicly owned parks and recreation areas, waterfowl and wildlife refuges and privately or publicly-owned historic resources must be addressed under the Section 4(f) provision of the National Transportation Act of 1966. In addition, properties which have received funding under the Land and Water Conservation Fund Act (LWCF), as administered by the United States Department of Interior (USDOI), require special evaluation including specific requirements for mitigation under Section 6(f) of the LWCF.

A total of five public facilities were identified within the study area including the Newington Elementary School on Nimble Hill Road and the NH Air National Guard station at the Pease Tradeport. A state bike path connecting Portsmouth with towns to the north runs along the western edge of the study area on Fox Point Road, Arboretum Drive and New Hampshire Avenue. A municipally-owned recreational site is also present in Newington - the Town Boat Launch on Patterson Lane.

Two state-owned parks are present in Dover: Hilton Park and Bayview Park. The State bike path crosses over the General Sullivan Bridge and follows Dover Point

Road to points north and east. No Land and Conservation Investment Program (LCIP) or Land and Water Conservation Fund (LWCF) properties are located within the study area.

In addition to these public facilities, numerous private businesses and residences are present within the study area. Dover Point has a high density of residential properties located on Dover Point Road and its side streets such as Wentworth Terrace, Cote Drive, Stevens Drive, Center Drive and Homestead Lane. Additional concentrations of residences and businesses are located on Boston Harbor Road. The study area in Newington tends to be predominantly commercial and industrial, particularly the Pease Tradeport and the areas adjacent to Woodbury Avenue, Shattuck Way and River Road.

Impacts

Impacts to public facilities can result from right-of-way takings for new roadway and structures. In Dover, Alternative 1 would result in approximately 0.9 acres of impact to Bayview Park for the reconstruction of the intersection of Spur Road and US 4. The realignment of Spur Road in this location is intended to facilitate the local connection to Boston Harbor Road. Dover Alternative 2 largely avoids impacts to Bayview Park, but does propose a new local connection between the east and west portions of Dover Point in the vicinity of Hilton Park. The total estimated resulting impact to Hilton Park is approximately 2.2 acres. Dover Alternative 3 impacts both Bayview Park with a reconfigured Spur Road intersection and Hilton Park with the same Dover Point Road connection described for Alternative 2. As a result, this Alternative will result in a total estimated impact of approximately 2.9 acres to these community parks.

Potential impacts to the public bike route will be avoided with any of the Bridge segment alternatives as a multi-use pathway will be incorporated in all of the bridge options. Potential impacts to the bike path in the Newington segment relate to proposed intersection changes (new or improved) along Arboretum Drive with the Woodbury Avenue extension (Alternative 6 Revised) or a new Pease Railroad Spur (Alternatives 7 and 9 through 12). In the Dover segment, changes to Dover Point Road (Alternatives 1-3) are not expected to impact the bike route if shoulder space is reserved. Intersection improvements, including a traffic signal, at US 4 and Boston Harbor Road/Spur Road will need to accommodate bicyclist movements under Alternatives 1 and 2. The proposed underpass for the connection of Boston Harbor Road with Spur Road under Alternative 3 would in fact provide a much safer and easier route for bicyclists heading to and from Dover.

Right-of-way impacts to residential and commercial properties will occur for all alternatives. Impacts can involve land acquisition, land and building acquisition, as well as temporary and permanent easements for drainage and construction activities. For this macro-level study, only those structures that are directly impacted by the widening footprint or those that were determined, by inspection, to be at risk because of the proximity of the footprint or loss of access were counted as impacted. These

impacts are reflected in Tables 5.3-1 and 5.3-2. The impacts are essentially the same for all 3-lane and 4-lane options and interchange alternatives. The difference in the 3-lane footprint versus 4-lane footprint (12 feet on each side of Turnpike) was deemed negligible at this level of evaluation.

In the Dover segment, Alternative 1 shows the greatest property displacement with fourteen residences and two businesses impacted, while Alternatives 2 and 3 each show two residences and one business impacted. In the Newington segment, only Alternatives 9 and 10 had one residential displacement each while one business is displaced by all six Newington alternatives. For the Bridge segment, the bridge option to replace the Little Bay Bridges "off-line" to the west would displace seven residences. This is the only Bridge option with residential property acquisitions.

5.3.1.10 Aesthetic and Visual Resources

Existing Conditions

During the scoping phase of this project, comments were received that described the Spaulding Turnpike through the study area as the veritable "gateway" to New Hampshire's lakes and North Country. While much of the study area is urbanized with commercial or industrial development, other areas contain visual elements characteristic of agricultural (*e.g.,* portions of Nimble Hill Road) or coastal environments (*e.g.,* the view from the Little Bay Bridges). Thus, portions of the study area, particularly those in the immediate vicinity of the Little Bay, have a relatively rich concentration of visual elements and can be considered scenic. It should also be noted that topography or existing forested buffers screen the road from large parts of the surrounding commercial and residential neighborhoods, which helps to shield these areas from the highway.

Impacts

Increasing the cross-section of a roadway (*e.g.,* widening from four lanes to either six or eight lanes) can increase the visual scale of the road and change the character of the surrounding areas. Impacts can result from an increase in road height, allowing portions of the highway to become visible where they were not previously. Widening can also eliminate forested buffers which can adversely affect local neighborhoods.

In Newington, all alternatives propose to realign the highway, shifting both northbound and southbound barrels into the forested median in the vicinity of Exit 4. This will result in a minor adverse effect to users of the highway, since the existing buffer between the lanes will be eliminated. Other visual effects will result from the construction of new roadway infrastructure to make an east-west connection across the highway in the vicinity of Exits 3 and 4 (depending on the alternative). It should be noted that the character of the study area in Newington is largely urbanized or industrialized (with the exception of the upper portion of Nimble Hill Road), so aesthetic effects could be characterized as largely minor.

In Dover, all alternatives would remove portions of the buffer between the Dover Point Road residential neighborhood in the vicinity of Cote Drive and Hilton Road. This would have the effect of exposing portions of the widened highway to residences that are not currently in view of the roadway. Because of an additional roadway in this area, Alternative 1 would have a greater impact on this neighborhood than Dover Alternatives 2 and 3.

Additionally, Dover Alternative 1 would remove the existing buffer between the Homestead Lane residential neighborhood and Exit 6. This impact is a result of construction of a new northbound on-ramp between Homestead Lane and the Turnpike, and could have a substantial adverse effect on residents of this area.

As described above, users of the highway experience a particularly scenic viewpoint from the Little Bay Bridges. Thus, changes in the vertical alignment of the rehabilitated or replacement bridge may affect the view from the roadway. This potential effect is not expected to differ substantially among the various bridge alternatives. However, residents of the area have noted that the bridges themselves, especially the General Sullivan Bridge, serve as a landmark and an interesting visual feature to motorists as well as boaters on the Little Bay and the Piscataqua River. Thus, its removal may have a minor adverse effect to motorists, boaters, and users of Hilton Park.

5.3.1.11 Cultural Resources

Extant historic structures and their archeological remains, as well as pre-contact archeological artifacts, are protected cultural resources. Section 106 of the National Historic Preservation Act and Section 4(f) of the Department of Transportation Act of 1966, protect resources that are listed in or are eligible for listing in the National Register of Historic Places. Below, the resources within the study area and the process used to preliminarily identify potential impacts are discussed.

Existing Conditions

Historic Structures

Perhaps the most conspicuous historic structure within the study area is the General Sullivan Bridge, built in 1935, which replaced the covered Boston and Maine (B&M) Railroad and highway bridge over Little Bay. In 1988, representatives from NHDOT, the NH Division of Historical Resources (NHDHR), and the FHWA reviewed the General Sullivan Bridge and deemed the bridge eligible for the National Register of Historic Places. Three other properties in the study area are currently listed or eligible for listing in the National Register of Historic Places: the Railroad Station/Toll House at Bloody Point, the Louis C. DeRochemont Mansion in Newington, and the First Parish Church Site in Dover.

In addition to these known listed or eligible structures, a survey of the study area found 128 structures that are at least 50 years old (*i.e.,* the threshold for consideration for listing in the National Register of Historic Places). These structures represent all eras of historical development in Newington and Dover, from the earliest agricultural settlement in the eighteenth century to the summer cottages and industrial complexes constructed on the Piscataqua River in the early twentieth century. Additional survey of these structures and further consultation with NHDOT and the NHDHR has narrowed the list of "potentially eligible" properties to 19 properties in Newington and Dover, as listed in Table 5.3-3.

Table 5.3-3
Historic Structures and Properties

Property Code	Description
NWN0205	Isaac Dow House Federal Italianate, c. 1820/c. 1869 Woodbury Avenue
NWN0204	Beane Farm Colonial Revival, c. 1903 Woodbury Avenue
NWN0201	Yeaton Farm c. 1738 Patterson Lane
--	Pease Air Force Base Cold War Era Military Base c. 1954
NWN0169	Axel Johnson Conference Center Colonial Revival Holden House, Early 20th Century Moved, c. 1965 Bloody Point Road
NWN0168	Newington Railroad Depot/Toll House Vernacular Frame Structure, c. 1873 Bloody Point Road
--	General Sullivan Bridge Continuous Steel Truss Highway Bridge, 1934
--	Hilton State Park Early 20th Century Public Park, 1938
DOV0154	15 Wentworth Terrace Summer Cottage, c. 1925
DOV0093	Ira F. Pinkham House Vernacular Sidehall Plan House, c. 1853 430 Boston Harbor Road

Table 5.3-3
Historic Structures and Properties (continued)

Property Code	Description
DOV0098	Charles Morang House Connected Farm Complex, c. 1878 419 Boston Harbor Road
DOV0099	Coleman House Federal Style Brick Cape, c. 1812 416 Boston Harbor Road
DOV0100	William Card House Federal Style Brick Cape, c. 1820 415 Boston Harbor Road
DOV0109, 0110, 0111, 0112	Chapman Cabins Early 20th Century Summer Cottages, c. 1930s Boston Harbor Road
DOV0113	Summer Cottage/Boathouse Vernacular Boathouse, c. 1925 Boston Harbor Road
DOV0146	Dover Point Road Area House, Store and Barn, c. 1850; and 2 Summer Cottages, c. 1930 Dover Point Road
DOV0136	School House/Church Vernacular Frame Schoolhouse, c. 1886
DOV0135	Federal Style House, c. 1810 Dover Point Road
DOV0134	Center Chimney Georgian House, c. 1750 Dover Point Road

It is important to note that further study of historic structures will be necessary to determine which of the potentially eligible properties are actually eligible for the National Register. The properties listed above are those that appear to be most intact and architecturally significant and are therefore the highest priority. However, surveys of these and other structures are on-going, and determination of eligibility consultations have yet to be initiated. The results of the environmental screening must accordingly be regarded as preliminary. More complete results of this research and coordination will be reported in the Draft EIS.

Archeological Resources

Preliminary Phase IA studies of archeological resources indicated that the study area contains 16 known (verified) archeological sites and 20 areas of archeological

sensitivity, as described in the March 2004 Scoping Report. These sites include terrestrial and marine resources preserved as ruins, features, archeological sites and probable archeological sites. Known archeological resources are dateable to both pre-contact Native American and historic Euro-American occupancy of the study area.

Subsequent field survey has further defined areas of resource sensitivity for the occurrence of Native American and historic sites. Of the twenty areas identified as sensitive during Phase 1A field work, 11 areas are intersected by one or more of the proposed roadway alternatives. Walkover surveys were completed of these areas, focusing on the centerline of the proposed alternative. Based on this additional work, six areas are recommended for further study due to their potential archeological resource sensitivity. Four areas are no longer considered sensitive due to lack of integrity, and one historic site had been previously determined to not exhibit significance and is no longer considered. Full results of this field work and the subsequent recommendations are available in a table in the *Phase I-A Archeological Reconnaissance* report by Victoria Bunker and Associates, dated October 2004[19]. Information on the six areas of concern is contained in Table 5.3-4.

Table 5.3-4
Archeological Resource Sensitivity Based on Field Inspection, May 2004

Area[1]	Location	Sensitivity & Recommendations
3	Dover, Homestead Lane to Exit 6	Sensitivity for early historic period settlement and subsequent agricultural use, Phase I-B sampling to define site presence
13	Dover, south side of Route 4 at Boston Harbor Road Intersection	Sensitivity for brickyard site, Phase I-B sampling to define subsurface context
14	Dover, residential and commercial area between Boston Harbor Road and Spaulding Turnpike	Sensitivity for historic domestic components associated with residences and for Native American settlement, Phase I-B sampling to define site presence
20	Dover, section bracketed by Boston Harbor Road, Route 4 and Spaulding Turnpike	Sensitivity for historic land use and agriculture from period of early settlement and for railroad features, Phase I-B sampling to define site presence
33	Newington, Dirty Gut, tributary of Pickering Brook	Sensitivity for pre-contact Native American along stream, Phase I-B sampling to define site presence
36	Newington, vicinity of Patterson Lane in field and wooded strip associated with Rollins Farm and Rollins Depot	Sensitivity for historic land use and agriculture from period and for railroad features including Rollins Depot, Phase I-B sampling to define site presence

[1] "Area" is a reference to codes assigned during 2003 Phase 1A field work to identify areas of archeological sensitivity. See Figure 3.13-2 of the March 2004 Scoping Report.

[19] Victoria Bunker, Inc., 2004. Phase I-A Preliminary Archeological Reconnaissance. Unpublished Report to the New Hampshire Department of Transportation.

Impacts

Historic Structures

The Newington-Dover project can affect historic properties by the direct taking of structures by an expanded roadway or by altering the setting of the historic property in an adverse manner. To estimate potential impacts to historic structures, the footprint of each alternative was overlaid onto a map containing the locations of the known listed or eligible historic properties as well as the high priority structures listed in Table 5.3-3. An impact was counted if the footprint of the alternative intersected any portion of the property on which the structure was located.

None of the proposed roadway alternatives impact any of the currently-listed structures in Newington or Dover. However, all roadway alternatives have the potential to impact potentially historic structures, as discussed below.

In the Newington Segment, all alternatives have the potential to affect the 18th century Isaac Dow House and the Beane Farm, located directly across from each other on Woodbury Avenue. These impacts result from the proposed expansion of the northern portions of Woodbury Avenue from two lanes to four lanes. The original conceptual layouts would result in the total acquisition of the Isaac Dow House. After consultation with NHDOT and NHDHR, alternative layouts will allow for a reduction of impacts. These alternatives will be further explored in the Draft EIS.

Additionally, all Newington alternatives impact, to one degree or another, property associated with the former Pease Air Force Base. This property is under consideration as a historical resource.

Only one historic structure – the General Sullivan Bridge – is potentially impacted within the Bridge Segment. Any alternative which proposes removal of the bridge would have an obvious and adverse effect on this resource. See Section 4.5 of this Rationale Report for a discussion of the potential bridge alternatives, and Tables 5.3-1 and 5.3-2 for preliminary estimates of the costs of each bridge alternative. The EIS will present alternatives to retain or remove the General Sullivan Bridge. Like any other 4(f) resource, removal or rehabilitation of the General Sullivan Bridge can only be carried out after the determination is made that implementation of other alternatives would result in extraordinary costs, and/or social, economic, or environmental impacts (*i.e.*, Section 4(f) evaluation). In addition, the proposed project must include all possible planning to minimize harm to the historic bridge under Section 106 of the NHPA.

Within Dover, Alternative 1 would impact as many as six potentially historic properties, whereas Alternatives 2 and 3 would impact only four. All three alternatives would result in small strip takings that could affect three structures of a Dover Point Road Area property (DOV0146) as well as the Charles Moreng House (DOV0098) on Boston Harbor Road. Dover Alternative 1 would also result in the

acquisition of two late 18th to early 19th century homes on Boston Harbor Road (DOV0093 and DOV0099).

Archeological Resources

Archeological resources, whether historical or Native American, can be impacted by grading and other land disturbance during highway construction. Typically, the extent of impact to archeological resources is limited to the footprint of the disturbed area. Thus, impacts to archeological resources were estimated by counting the number of sensitive areas impacted by a particular alternative. Each separate area of disturbance was counted. The total number of impacts for a given alternative may exceed the total number of sensitive areas (Table 5.3-4) since certain sensitive areas were crossed two or more times.

All of the sensitive areas listed in Table 5.3-4 are impacted by the project. Note that the three Dover alternatives all have similar impacts – they each cross the four sensitive areas in Dover a total of seven times. In contrast, there is some difference among the Newington alternatives. Specifically, Newington Alternatives 6 through 10 impact two or three archeologically sensitive zones. In contrast, Alternatives 11 and 12 impact five or six areas, respectively. These impact areas are associated with additional crossing of the "Dirty Gut" area of Newington – *i.e.*, the area associated with Railway and Pickering Brooks which is potentially sensitive for pre-contact Native American sites.

5.3.1.12 Potential Hazardous & Solid Waste Sites

Existing Conditions

Preliminary review of the study corridor indicates a large number of properties that may contain petroleum, hazardous or solid waste contamination, based on the long history of commercial and industrial land use within the corridor. These areas present a constraint because of possible safety concerns during construction and the expense of remediation. Among these sites is the National Priorities List (NPL) or superfund site associated with the former Pease Air Force Base. Other potential sites are associated with previous releases of hazardous or petroleum materials and leaking underground storage tanks. No active solid waste landfills are located within the study area.

Impacts

To determine the relative potential impacts to sites of potential contamination, the footprint of each alternative was overlaid onto a map showing all hazardous materials sites. An impact was counted if any portion of the footprint intersected with any portion of the property on which the hazardous materials site occurred. For purposes of this preliminary screening, all types of hazardous materials sites, including, for example, Resource Conservation and Recovery Act (RCRA) generators, were

included. It should be noted that not all of the different types of sites have the same potential to impact the project.

The analysis indicates that there does not appear to be any substantial difference among any of the alternatives proposed. In the Newington Segment, all alternatives potentially impact between five and seven hazardous material properties, largely concentrated on low-risk RCRA generators or remediated spill sites adjacent to Woodbury Avenue.

No potentially contaminated sites will be impacted within the Bridge Segment.

The Dover Alternatives also have largely similar impacts. All Dover alternatives impact a former marina at the terminus of Dover Point Road south of Cote Drive. This marina is the location of a known leaking underground storage tank and underground injection well. Dover Alternatives 2 and 3 also impact the site of an underground storage tank on Boston Harbor Road.

6

Alternatives Recommended for Further Study

6.1 Summary of Recommendations

In an effort to narrow the broad range of alternatives identified in the Scoping Report as possible ways to address the needs of the Spaulding Turnpike in the study area, the NHDOT and FHWA have evaluated the merits and potential impacts of these alternatives. The evaluation has considered technical analysis and public input and environmental agency review. This Section provides a summary of recommendations developed as a result of the technical evaluations completed, public input provided, and environmental review.

6.1.1 No-Build

The No-Build Alternative is not considered a viable alternative, but will serve as a baseline condition for comparison with other alternatives.

6.1.2 Mode Options

Based on the study of potential ridership and its effect on highway operations, bus service, rail service and the use of HOV lanes either alone or in combination with each other, do not eliminate the need to widen the bridges and Turnpike, if acceptable levels of service are to be achieved for the 2025 design year. The mode options would help alleviate the length of time each day during which congestion occurs, but peak hour congestion will remain.

Comparison of the rail and bus alternatives under the 6-lane Build condition indicates that Alternative 1B (expanded Downeaster service to Rochester with an addition of one daily round trip) provides more than two times the peak hour traffic volume reduction provided by Alternative 2B (Rochester-Portsmouth commuter rail) at approximately 8 percent ($10.3M) of the capital cost of Alternative 2B ($157.1M).

Alternative 1B is an expansion of an existing service provided over existing rail lines, as opposed to Alternative 2B which entails new service requiring the acquisition of new right-of-way (at additional cost and potential environmental, property and cultural impacts) paralleling the Turnpike between Dover station and Bloody Point in Newington. Similarly, Rail Alternative 1A – with its Dover Terminus – provides almost twice the peak hour traffic volume reduction as provided by Rail Alternative 2B, at relatively the same fraction (7 percent) of the cost of Alternative 2B. As such, Rail Alternatives 1A and 1B are the only passenger rail alternatives recommended for further study and assume that the expanded service can be operated without double-tracking 30 miles between Dover station and the Massachusetts state line.

Expanded intercity bus service (Alternative 1) between Rochester and Boston will improve an already good commuter service. Increasing peak hour service and providing new park-and-ride facilities will enhance the express bus service (Alternative 2) between Rochester and Portsmouth proposed by COAST for 2006 implementation. Also, reducing headways and providing better connectivity (Alternative 3) will enhance local bus service. Bundling all three bus service enhancements has an estimated capital cost of $10.6M. It is recommended that all three bus alternatives be advanced for further study as potential cost-effective means of reducing peak hour travel demand within the study area.

Of the HOV alternatives, Alternative B – running between the Dover Toll Plaza and Exit 1 in Newington – combined with an aggressive employer-TDM program, Bus Alternatives 1-3 and Rail Alternative 1B, diverts enough traffic from the three general purpose lanes to provide LOS D in the morning and evening weekday peak hours. Available reserve capacity in the weekday PM peak hour is approximately 7 percent. Of the HOV cross section alternatives, the zipper lane concept (124′ to 128′ wide) is approximately 22′ to 30′ narrower than both the 7-lane contraflow concept (148′ to 152′ wide) and the 8-lane concurrent flow concept (146′ to 158′) and as such would result in a smaller footprint and less impacts. On the other hand, the zipper lane will entail capital equipment costs and higher than typical maintenance and operating costs.

Alternatively, assuming that the HOV alternatives were open to general or all traffic, the 7-lane cross section (**Figure 3.2-1**)would provide approximately the equivalent peak hour capacity of the 8-lane build cross sections (**Figures 2.2-3 and 3.2-2**). In comparison to the HOV lane operation, the four general use lanes would also operate at LOS D in the AM and PM peak hour, and would provide additional PM peak hour reserve capacity ranging from 15 percent (no non-SOV Alternatives) to 21 percent (with Aggressive TDM, Bus Alternatives 1 - 3 and Rail Alternative 1B). The zipper lane alternative (**Figure 3.2-2**), if operated as a general purpose lane, would provide the same peak hour traffic operations with a cross section (124′ to 128′) that is approximately 24 feet narrower than the 7-lane (148′ to 152′) contraflow HOV cross section.

It is recommended that the 8-lane concurrent flow HOV (**Figure 3.2-2**), the 7-lane HOV contraflow (**Figure 3.2-1**), and the 6-lane with contraflow zipper lane (**Figure 3.2-2**) alternatives be advanced for further study as either HOV or general traffic use facilities running between the Dover Toll Plaza and Exit 1 (Pease Boulevard/Gosling Road).

6.1.3 Highway and Bridge Widening

6.1.3.1 Main Line

Future 2025 travel demands require four basic travel lanes in both the northbound and southbound directions of the Spaulding Turnpike between Exit 3 and Exit 6. South of Exit 3 (three basic lanes in each direction) and north of Exit 6 (two basic lanes in each direction), fewer lanes are required. Preliminary analysis of mode options indicates the potential to reduce peak hour traffic volumes by varying degrees depending on the alternative. While the preliminary analysis of individual and combinations of mode options does not appear to reduce the future peak hour traffic demand enough so that three basic (general purpose) lanes on the bridge and Turnpike in each direction will provide a satisfactory level-of-service (LOS 'D'), the NHDOT believes it is prudent to carry the basic 6-lane (three lanes in each direction) alternative forward for further study. As such, both the basic 6-lane and 8-lane bridge/highway widening alternatives are recommended to be carried forward.

6.1.3.2 Bridge Alternatives

Fourteen bridge alternatives were developed; these consisted of six On-line Bridge Widening Alternatives, six On-line Bridge Replacement Alternatives, and two Off-line Signature Bridge Alternatives. The estimated costs and impacts of each of these alternatives were calculated and then compared in order to determine which alternatives were cost effective, minimized impacts and would be recommended for further study in the DEIS.

In comparison, the On-line Widening Alternatives and the On-line Replacement Alternatives have similar impacts, but the Widening Alternatives have substantially lower costs. Evaluating the options, the added costs for the Replacement Alternatives do not justify the minimal improvement they provide in increasing stopping sight distance, from 60 MPH to 70 MPH. The posted speed limit is 50 MPH; therefore, the On-line Replacement Alternatives were eliminated in favor of the On-line Widening Alternatives.

Within the On-line Widening Alternatives, the costs are similar; therefore, the differentiating factors are the impacts to Hilton Park and the estuarine wetlands near Bloody Point. Both the Widen East and Widen Both Sides Alternatives have greater impacts to these resources than the Widen West Alternatives. Widening to both sides is also more difficult to construct while maintaining traffic. As such, the Widen East

and Widen Both Sides Alternatives were eliminated in favor of the Widen West Alternatives.

The difference between the remaining two On-line Widen West Alternatives is the disposition of the General Sullivan Bridge. One alternative removes the General Sullivan Bridge and provides an integrated multi-use path on the widened bridge, while the other alternative rehabilitates the General Sullivan Bridge and utilizes it as a multi-use path, or multi-use path and transit use only facility, or multi-use path and transit and local traffic use. The alternative that removes the General Sullivan Bridge has lower initial costs and lower long-term maintenance costs, but the alternative that retains the General Sullivan Bridge has a high degree of community support and has less impact to the historic structure. Both alternatives were recommended for further study in the DEIS.

The Off-line Signature Bridge Alternatives, concrete arch and cable-stayed, have substantially higher costs and residential property impacts than any of the other alternatives; however, these structures address concerns raised by the community about a recognizable "gateway" at this location and permit an improvement of the bridge profile. They also provide potential mitigation for the removal of the General Sullivan Bridge. Therefore, both of these alternatives are recommended for further study in the DEIS.

6.1.3.3 Highway Alternatives

The highway alternatives developed for the Dover and Newington segments, and described in Chapter 4, were screened at a macro-level and compared to one another (Tables 5.3-1 and 5.3-2) for ability to meet the project's purpose and need while minimizing potential impacts to study area resources. The screening process included comparative assessment of the following areas: potential impact on the natural environment, cultural resources, parkland and recreation areas; wildlife habitat; property impacts; traffic operations, transportation system efficiency and safety; local connectivity; community support; and cost. The process was also conducted within a dynamic public participation process involving many stakeholders: residents of Dover and Newington, Advisory Task Force (ATF) members, representatives from the Strafford Regional Planning Commission and Rockingham Planning Commission, state and federal resource agency representatives, representatives of area public transit operators including the Cooperative Alliance for Seacoast Transportation (COAST) and the University of New Hampshire Wildcat Transit, the US Coast Guard, the Federal Highway Administration (FHWA), the Federal Aviation Administration (FAA) and the NHDOT. Community input was facilitated and channeled via regularly scheduled project advisory task force meetings, public informational meetings, and meetings and field trips with the resource agency representatives. The evaluations and screening process were open and incremental in nature, and amounted to a "give and take" exchange by most stakeholders in striving to discover the most practicable transportation solutions that achieve the best possible balance of impacts. As some alternatives were being discarded for various impact-related

reasons, other alternatives were being created or modified from previous alternatives. The process was open, dynamic and subject to continual review.

For example, Alternative 1 in Dover was eliminated due to its impacts on groundwater, wetlands, residential properties, historic properties, and its poor local connectivity, lack of community support and cost. Alternatives 6 Revised, 7, 8 and 9 in Newington were similarly dismissed. Alternative 6 Revised lacked good connectivity between the industrial area and the Turnpike, and between Nimble Hill Road and Woodbury Avenue. Alternative 7 has an adverse visual impact due to its elevation above the adjacent terrain, would provide a free-flowing direct southbound connection to Woodbury Avenue which is counter to the community objective of calming traffic entering Woodbury Avenue, is the most costly of all alternatives, and includes a double northbound on-ramp to the Turnpike which results in a problematic traffic merging condition prior to the Little Bay Bridges. Both Alternatives 6 Revised and 7 fell out of favor with Newington officials during the review process. Alternative 8 attempted to reduce the scale of Alternative 7 by substituting a compact diamond interchange for a single-point urban interchange. Alternative 8 failed from a traffic operations perspective and were never brought forward for public discussion. Alternative 9 had several traffic operational shortcomings including a problematic double loop ramp for southbound exiting traffic at Exit 3, and elimination of access to River Road at Exit 4.

On the other hand, the assessment of alternatives and relative comparison of one alternative with another identified a number of positive characteristics and benefits common to Alternatives 2 and 3 in Dover and Alternatives 10, 11 and 12 in Newington:

- Improved safety and traffic operating conditions
- Improved local connectivity
- Higher levels of community support
- Less environmental impacts
- Less impacts to public lands and cultural resources
- Less cost

Based on this screening and evaluation, the following highway alternatives are recommended for further study:

- Alternative 2 (**Figure 4.4-9**) in Dover
- Alternative 3 (**Figure 4.4-10**) in Dover
- Alternative 10 (**Figure 4.4-5**) in Newington
- Alternative 11 (**Figure 4.4-6**) in Newington
- Alternative 12 (**Figure 4.4-7**) in Newington

6.1.4 TSM Improvements

The TSM improvements identified and described in Chapter 4, Section 4.6 (**Figures 4.5-1, 4.5-2, 4.5-3 and 4.5-4**) will all be carried forward into the DEIS. Some of the improvements are actively being pursued and implemented as part of other projects to provide immediate safety benefits.

6.1.5 TDM Measures

In addition to the rail, bus, HOV and zipper lane alternatives discussed previously under Section 6.1.2, Mode Options, the employer-based measures described in Chapter 2, Section 2.2.3, are recommended to be carried forward. In addition, in support of these measures and the previously described Bus Alternatives 1, 2 and 3, new park-and-ride facilities at Exit 12 in Rochester, Exit 9 in Dover and at the US 4/NH 108 Interchange in Durham are also recommended to be carried forward and developed in more detail in the DEIS.

6.2 Alternatives Carried Forward into DEIS

The following alternatives have been endorsed by the ATF and will be carried forward into the development of the DEIS for further detailed evaluation:

- The No-Build Alternative which essentially serves as a basis for purposes of comparison with the Build Alternatives.
- Transportation Systems Management (TSM) measures, as described previously, that address current traffic operational and safety problem areas.
- Transportation Demand Management (TDM) measures which will provide alternatives to single occupancy vehicular travel. Specifically, the following measures will be carried forward:
  - Rail Alternative 1A – Expanded Downeaster Service to Dover (without double tracking of Main Line West).
  - Rail Alternative 1B – Expanded Downeaster Service to Rochester (without double tracking of Main Line West).
  - Restoration of the Pease Spur.
  - Bus Alternative 1 – Expanded Intercity Bus Service (Rochester-Boston).
  - Bus Alternative 2 – Expanded Express Bus Service (Rochester-Portsmouth).
  - Bus Alternative 3 – Expanded Local Bus Service.
  - Promotion of employer-based measures utilizing incentives to encourage employees not to commute alone.
  - New park-and-ride facilities in Rochester, Dover and Durham. (These facilities are carried forward as part of the three Bus Alternatives.)

- Bridge Alternatives – All located to the west side of the existing Little Bay Bridges:
  - Rehabilitation and widening of the Little Bay Bridges to either 6 or 8 lanes with the General Sullivan Bridge Rehabilitation.
  - Rehabilitation and widening of the Little Bay Bridges to either 6 or 8 lanes with the General Sullivan Bridge Removed.
  - Replacement of the Little Bay Bridges with a new 6 or 8-lane bridge and General Sullivan Bridge Removed.

- Highway Alternatives – Either 6 or 8 basic lanes along the Turnpike and Little Bay Bridges for the following Alternatives:
  - Alternative 2 (**Figure 4.4-9**) in Dover
  - Alternative 3 (**Figure 4.4-10**) in Dover
  - Alternative 10 (**Figure 4.4-5**) in Newington
  - Alternative 11 (**Figure 4.4-6**) in Newington
  - Alternative 12 (**Figure 4.4-7**) in Newington

- In addition, it is also recommended that the 7-lane HOV contraflow alternative (**Figure 3.2-1**), the 8-lane HOV concurrent flow alternative (**Figure 3.2-2**) and the 6-lane with contraflow zipper lane alternative (**Figure 3.2-2**), running between the Dover Toll Plaza and Exit 1 (Pease Boulevard/Gosling Road), be carried forward into the development of the DEIS for further study as either HOV or general traffic use alternatives.

These alternatives will be evaluated in more detail and subject to additional agency and public input to determine associated impacts, costs, and permitting issues which will be documented in the DEIS. Following distribution of the DEIS for review and comment, the NHDOT will hold a Public Hearing and present the Preferred Alternative. The Public Hearing will be conducted jointly with the New Hampshire Department of Environmental Services (NHDES) Wetlands Bureau and the US Army Corps of Engineers (ACOE).

Upon completion of a successful Public Hearing, comments on the DEIS and input received from the hearing will be addressed in a Final Environmental Impact Statement (FEIS). The FEIS will identify the NHDOT's Selected Alternative.

Appendices

- Appendix A: Advisory Task Force (ATF) Meetings
  Resource Agency (RA) Meetings
  Public Information (PIM) Meetings
- Appendix B: Rail and Transit Capital Cost Estimates
- Appendix C: RSG Memorandum on Revised Land Use Model Assumptions and Peak Traffic Shifting Methodology

Appendix A — Advisory Task Force (ATF) Meetings

ADVISORY TASK FORCE (ATF) MEETINGS

Meeting No.	Date/Location	Topics
Meeting 1	Wednesday, April 30, 2003 Newington Town Hall	Kick-Off Meeting; Role of ATF and Scope of Project.
Meeting 2	Wednesday, July 30, 2003 Dover City Hall	Update of Environmental Resource Inventories and Traffic Data Collection; Presentation of Preliminary Findings of the Seacoast Travel Survey; Review of Issues identified at the June 25, 2003 Scoping Meeting; Update of Status of the Regional Travel Demand Model; Review of the Potential Range of Alternatives to be considered in the DEIS; Review of Project Purpose and Need Statement; and Review of Toll-Related Issues.
Meeting 3	Wednesday, October 29, 2003 Newington Town Hall	Reviewed and Finalized Project Purpose and Need Statement; Update of Environmental Resource Inventories; Review of Preliminary Bridge Investigations; Update of Regional Travel Demand Model and Findings from Seacoast Travel Survey; Summary of Study Area Safety and Traffic Deficiencies and Issues; Review of the Study Area's Transit and Rail Systems; Summary of Socio-Economic characteristics of the Study Area with respect to Journey-to-Work Data; Update of the Intelligent Transportation System (ITS) Plan and Incident Management Initiatives for the Study Area and Region; Summary of the Draft Ten Year Transportation Improvement Program as it relates to the Newington-Dover Project; Discussion of Funding Near-Term Improvements to address current Safety and Traffic Operational Problems,; and Discussion of a Long-Term Vision for the Study Area.
Meeting 4	Wednesday, January 28, 2004 Dover City Hall	Update on the Regional Travel Demand Model; Preliminary Summary Review of the Scoping Report (to be distributed in March 2004); Discussion of Navigation-Related Issues; Discussion of the Historical Significance of the General Sullivan Bridge; Preliminary Discussion of Short-Term TSM-Type Improvement Alternatives; Discussion of Potential Park-and-Ride Sites; and Discussion of a Long Term Vision for the Study Area.
Meeting 5	Wednesday, March 31, 2004 Newington Town Hall	Review of Bridge Characteristics and Conditions; Review of Preliminary Bridge, Turnpike and Interchange Conceptual Alternatives; Review of Short-Term TSM-Type Alternatives; Unanimous ATF Endorsement for Implementation of the TSM Measures; Review of Long-Term Interchange Alternatives in Dover and Newington; Unanimous ATF Endorsement of Alternative 3 in Dover to be advanced for Further Analysis in Phase 3 (DEIS); and ATF Consensus to drop Alternative 7 in Newington from Further Consideration.

Meeting No.	Date/Location	Topics
Meeting 6	Wednesday, April 28, 2004 Newington Town Hall	Reviewed Bridge Navigation and Permitting Issues, and the History, Reuse Alternatives and Issues related to the General Sullivan Bridge; Review of Bridge and Roadway Conceptual Alternatives, Potential Impacts and Cost Estimates; Discussion and Visualization of Level-of-Service for varying traffic conditions along the Spaulding Turnpike; Unanimous ATF endorsement of advancing three bridge alternatives – Rehabilitation and Widening of the Little Bay Bridges (LBB) with the General Sullivan Bridge (GSB) rehabilitated, Rehabilitation and Widening of the LBB with the GSB removed, and Replacement of the LBB with the GSB removed; Unanimous ATF endorsement of advancing roadway Alternatives 2 and 3 in Dover and Alternatives 10 and 11 in Newington for further study in Phase 3 (DEIS).
Meeting 7	Wednesday, June 23, 2004 Dover City Hall	Review of Preliminary Ridership Estimates of TDM Alternatives including Rail, Bus, HOV and Reversible Lanes, and Employer-based Programs; Review of Preliminary Screening of Impacts and Costs associated with Conceptual Bridge and Roadway Alternatives; Presentation and Discussion of Study Team's Recommended Range of Alternatives to be advanced to Phase 3 (DEIS) Analysis; Unanimous ATF endorsement of the Recommended Range of Alternatives to carry forward.
Meeting 8	Wednesday, August 25, 2004 Newington Town Hall	Review and response to comments and questions from Public Information Meetings of 6/30/04 and 7/01/04; Review and discussion of refined ridership estimates associated with Rail, Bus, HOV and other TDM Alternatives; Review, refinement and comparison of impacts and costs associated with the range of alternatives; and Review of Project Schedule.

Resource Agency (RA) Meetings

RESOURCE AGENCY MEETINGS

Meeting No.	Date/Location	Topics
Phase I		
Project Scoping/Data Collection/Issue Identification		
Meeting 1	Wednesday, April 16, 2003 NHDOT Headquarters, Concord, NH	Introduction to the project, including the project schedule and preparation for upcoming Scoping Meeting.
Meeting 2	Wednesday, July 16, 2003 NHDOT Headquarters, Concord, NH	Review of feedback and comments received during the Scoping Meeting and comments on project Purpose and Need Statement.
Meeting 3	Wednesday, August 20, 2003 NHDOT Headquarters, Concord, NH	Review of project and discussion of socioeconomic and secondary effects.
Meeting 4	Thursday, September 11, 2003 NHDOT Headquarters, Concord, NH	SHPO coordination meeting to provide project overview, including EIS schedule and approach to historical and archeological field studies.
Meeting 5	Tuesday, October 7, 2003 Newington and Dover	Field visit to review the project corridor including natural resources and historic properties.
Phase II		
Conceptual Alternatives Development and Screening		
Meeting 6	Thursday, April 1, 2004 NHDOT Headquarters, Concord, NH	SHPO coordination meeting to discuss progress and preliminary findings of surveys to identify historic structures in the project corridor.
Meeting 7	Wednesday, April 21, 2004 NHDOT Headquarters, Concord, NH	Review of preliminary alternatives and screening methodology.
Meeting 8	Thursday, June 10, 2004 NHDOT Headquarters, Concord, NH	SHPO coordination meeting to discuss preliminary results of Phase 1A archeological investigations.
Meeting 9	Wednesday, June 23, 2004 NHDOT Headquarters, Concord, NH	Review of ridership, LOS, TDM, TSM, bridge and roadway alternatives.
Meeting 10	Friday, July 16, 2004 NHDOT Headquarters, Concord, NH	SHPO coordination meeting to discuss historic structures and environmental screening methodology.
Meeting 11	Thursday, August 5, 2004 Newington Town Hall	Further review of alternatives including TDM, LOS, and a 3-Lane Concept. Discussion of environmental screening of alternatives, including a draft constraints matrix. Presentation of the Alternatives recommended for further study in the Draft EIS.
Meeting 12	Thursday, August 5, 2004 Newington and Dover	Field review of natural resources of Little Bay, Hilton Point and other areas within the project corridor.
Meeting 13	Thursday, August 5, 2004 NHDOT Headquarters, Concord, NH	SHPO coordination meeting to review progress of the historic structures survey.

Public Information (PIM) Meetings

PUBLIC INFORMATION MEETINGS

Meeting No.	Date/Location	Topics
Meeting 1	Wednesday, June 25, 2003 Newington Town Hall	Project Scoping Meeting – Roles of Federal Lead Agency and Cooperating Agency Roles; Project Background; Project Purpose and Need; Study Area; Sensitive Environmental Issues; Reasonable Range of Alternatives; Project Phases and Schedule; and Solicitation and Response to Public Input.
Meeting 2	Wednesday, November 12, 2003 Dover City Hall	Reviewed project's scope, study area, and purpose and need. Reviewed the existing study area traffic conditions, accident data, and environmental resources. Described the preliminary bridge findings contrasting the Little Bay Bridges with the General Sullivan Bridge. Described the calibration and update of the Seacoast Travel Demand Model. Summarized the reasonable range of alternatives under consideration. Described the project process, schedule, and public participation. Solicited and responded to public input and comments.
Meeting 3	Wednesday, June 30, 2004 Dover City Hall	Reviewed Project Purpose and Need, Project Process and Schedule, and Project Background. Described Alternatives Conceptualized; Reviewed Preliminary Constraints/Impacts Matrix of Alternatives; Presented Range of Alternatives recommended for further study; Solicited and Responded to Public Input.
Meeting 4	Thursday, July 1, 2004 Newington Town Hall	Reviewed Project Purpose and Need, Project Process and Schedule, and Project Background. Described Alternatives Conceptualized; Reviewed Preliminary Constraints/Impacts Matrix of Alternatives; Presented Range of Alternatives recommended for further study; Solicited and Responded to Public Input.

Appendix B — Rail and Transit Capital Cost Estimates

Spaulding Turnpike Improvements - Transit Alternatives

Capital Costs

Rail/Fixed Guideway Alternative 1A: Expanded Downeaster Service (Dover-Boston) *with double-tracking, with traditional equipment*

Item	Quantity	Unit	Unit Price	Total Price
Infrastructure				
New Track	162,571	TF	$ 190	$ 30,888,528
New Interlocking	2	EA	$ 2,000,000	$ 4,000,000
Signals and Communications	162,571	LF	$ 90	$ 14,631,390
New U.G. Bridges (60' Span)	18	EA	$ 600,000	$ 10,800,000
Upgrade Existing Public Grade Crossing	16	EA	$ 175,000	$ 2,800,000
Grade Crossings - Private/Farm	7	EA	$ 50,000	$ 350,000
Layover Facility (2-450' Tracks)	1	LS	$ 1,323,000	$ 1,323,000
Dover Station Renovations				
Parking - 50 Additional Spaces	12750	SF	$ 12	$ 153,000
Durham Station Renovations				
Parking - 50 Additional Spaces	12750	SF	$ 12	$ 153,000
Subtotal - Infrastructure				***$ 65,098,918***
Infrastructure Contingency	30%			$ 19,529,675
Design/Permitting/Construction Phase Services	20%			$ 13,019,784
Infrastructure Total with allowances				***$ 97,648,377***
Rail Equipment				
Diesel locomotive	1	EA	$3,400,000	$ 3,400,000
Passenger coach	3	EA	$2,600,000	$ 7,800,000
Equipment Total				***$ 11,200,000***
GRAND TOTAL				**$ 108,848,377**

Notes:

1. Estimate does not include ROW acquisition costs.
2. Quantity of bridges and grade crossings is taken from Springfield Terminal Railway Company track charts.
3. Bridge costs in this alternative represent costs to add second span adjacent to existing undergrade bridges to accommodate double-track. Existing undergrade bridges can not be modified to accommodate a second track. Overhead bridges are assumed to have the necessary horizontal clearance to accomodate a double-track section.
4. Unit costs for new rail equipment based on average prices included in MBTA North-South Rail Link MIS Update (escalated to $2004).
5. Upgrade Existing Public Grade Crossing cost includes modifying the existing crossings using existing equipment to accommodate two tracks.
6. Cost of clearing/grubbing and fine grading of subgrade is included in new track cost.
7. Station costs do not include grade separated pedestrian crossings.

Spaulding Turnpike Improvements - Transit Alternatives

Capital Costs

Rail/Fixed Guideway Alternative 1A: Expanded Downeaster Service (Dover-Boston) *with double-tracking, with DMU equipment*				
Item	**Quantity**	**Unit**	**Unit Price**	**Total Price**
Infrastructure				
New Track	162,571	TF	$ 190	$ 30,888,528
New Interlocking	2	EA	$ 2,000,000	$ 4,000,000
Signals and Communications	162,571	LF	$ 90	$ 14,631,390
New U.G. Bridges (60' Span)	18	EA	$ 600,000	$ 10,800,000
Upgrade Existing Public Grade Crossing	16	EA	$ 175,000	$ 2,800,000
Grade Crossings - Private/Farm	7	EA	$ 50,000	$ 350,000
Layover Facility (2-450' Tracks)	1	LS	$ 1,323,000	$ 1,323,000
Dover Station Renovations				
Parking - 50 Additional Spaces	12750	SF	$ 12	$ 153,000
Durham Station Renovations				
Parking - 50 Additional Spaces	12750	SF	$ 12	$ 153,000
Subtotal - Infrastructure				***$ 65,098,918***
Infrastructure Contingency	30%			$ 19,529,675
Design/Permitting/Construction Phase Services	20%			$ 13,019,784
Infrastructure Total with allowances				***$ 97,648,377***
Rail Equipment				
3-Car Diesel Multiple Unit Consist (292 seats)	1	EA	$7,500,000	$ 7,500,000
		EA		$ -
Equipment Total				***$ 7,500,000***
GRAND TOTAL				**$ 105,148,377**

Notes:

1. Estimate does not include ROW acquisition costs.
2. Quantity of bridges and grade crossings is taken from Springfield Terminal Railway Company track charts.
3. Bridge costs in this alternative represent costs to add second span adjacent to existing undergrade bridges to accommodate double-track. Existing undergrade bridges can not be modified to accommodate a second track. Overhead bridges are assumed to have the necessary horizontal clearance to accomodate a double-track section.
4. Unit costs for new rail equipment based on advertised costs for a three car diesel multiple unit set (April 2004)
5. Upgrade Existing Public Grade Crossing cost includes modifying the existing crossings using existing equipment to accommodate two tracks.
6. Cost of clearing/grubbing and fine grading of subgrade is included in new track cost.
7. Station costs do not include grade separated pedestrian crossings.

Spaulding Turnpike Improvements - Transit Alternatives

Capital Costs

Rail/Fixed Guideway Alternative 1A: Expanded Downeaster Service (Dover-Boston) *without double-tracking, with traditional equipment*				
Item	**Quantity**	**Unit**	**Unit Price**	**Total Price**
Infrastructure				
New Track		TF	$ 190	$ -
New Interlocking		EA	$ 2,000,000	$ -
Signals and Communications		LF	$ 90	$ -
New U.G. Bridges (60' Span)		EA	$ 600,000	$ -
Upgrade Existing Public Grade Crossing		EA	$ 175,000	$ -
Grade Crossings - Private/Farm		EA	$ 50,000	$ -
Layover Facility (2-450' Tracks)	1	LS	$ 1,323,000	$ 1,323,000
Dover Station Renovations				
Parking - 50 Additional Spaces	12750	SF	$ 12	$ 153,000
Durham Station Renovations				
Parking - 50 Additional Spaces	12750	SF	$ 12	$ 153,000
Subtotal - Infrastructure				***$ 1,629,000***
Infrastructure Contingency	30%			$ 488,700
Design/Permitting/Construction Phase Services	20%			$ 325,800
Infrastructure Total with allowances				***$ 2,443,500***
Rail Equipment				
Diesel locomotive	1	EA	$3,400,000	$ 3,400,000
Passenger coach	3	EA	$2,600,000	$ 7,800,000
Equipment Total				***$ 11,200,000***
GRAND TOTAL				**$ 13,643,500**

Notes:

1. Estimate does not include ROW acquisition costs.

2. Unit costs for new rail equipment based on average prices included in MBTA North-South Rail Link MIS Update (escalated to $2004).

3. Station costs do not include grade separated pedestrian crossings.

Spaulding Turnpike Improvements - Transit Alternatives

Capital Costs

Rail/Fixed Guideway Alternative 1A: Expanded Downeaster Service (Dover-Boston) *without double-tracking, with DMU equipment*				
Item	**Quantity**	**Unit**	**Unit Price**	**Total Price**
Infrastructure				
New Track		TF	$ 190	$ -
New Interlocking		EA	$ 2,000,000	$ -
Signals and Communications		LF	$ 90	$ -
New U.G. Bridges (60' Span)		EA	$ 600,000	$ -
Upgrade Existing Public Grade Crossing		EA	$ 175,000	$ -
Grade Crossings - Private/Farm		EA	$ 50,000	$ -
Layover Facility (2-450' Tracks)	1	LS	$ 1,323,000	$ 1,323,000
Dover Station Renovations				
Parking - 50 Additional Spaces	12750	SF	$ 12	$ 153,000
Durham Station Renovations				
Parking - 50 Additional Spaces	12750	SF	$ 12	$ 153,000
Subtotal - Infrastructure				***$ 1,629,000***
Infrastructure Contingency	30%			$ 488,700
Design/Permitting/Construction Phase Services	20%			$ 325,800
Infrastructure Total with allowances				***$ 2,443,500***
Rail Equipment				
3-Car Diesel Multiple Unit Consist (292 seats)	1	EA	$7,500,000	$ 7,500,000
		EA		$ -
Equipment Total				***$ 7,500,000***
GRAND TOTAL				**$ 9,943,500**

Notes:

1. Estimate does not include ROW acquisition costs.

2. Unit costs for new rail equipment based on advertised costs for a three car diesel multiple unit set (April 2004)

3. Station costs do not include grade separated pedestrian crossings.

Spaulding Turnpike Improvements - Transit Alternatives

Capital Costs

Rail/Fixed Guideway Alternative 1B: Expanded Downeaster Service (Rochester-Boston) *with double-tracking, with traditional equipment*				
Item	**Quantity**	**Unit**	**Unit Price**	**Total Price**
Infrastructure				
New Track	162,571	TF	$ 190	$ 30,888,528
New Interlocking	2	EA	$ 2,000,000	$ 4,000,000
Signals and Communications	162,571	LF	$ 90	$ 14,631,390
New U.G. Bridges (60' Span)	18	EA	$ 600,000	$ 10,800,000
Upgrade Existing Public Grade Crossing	16	EA	$ 175,000	$ 2,800,000
Grade Crossings - Private/Farm	7	EA	$ 50,000	$ 350,000
Layover Facility (2-450' Tracks)	1	LS	$ 1,323,000	$ 1,323,000
Rochester Station				
Canopy - 50'	1	LS	$ 50,000	$ 50,000
Platform	450	TF	$ 75	$ 33,750
Parking - 50 Spaces	12750	SF	$ 12	$ 153,000
Access	1	LS	$ 30,000	$ 30,000
Dover Station Renovations				
Parking - 50 Additional Spaces	12750	SF	$ 12	$ 153,000
Durham Station Renovations				
Parking - 50 Additional Spaces	12750	SF	$ 12	$ 153,000
Subtotal - Infrastructure				***$ 65,365,668***
Infrastructure Contingency	30%			$ 19,609,700
Design/Permitting/Construction Phase Services	20%			$ 13,073,134
Infrastructure Total with allowances				***$ 98,048,502***
Rail Equipment				
Diesel locomotive	1	EA	$3,400,000	$ 3,400,000
Passenger coach	3	EA	$2,600,000	$ 7,800,000
Equipment Total				***$ 11,200,000***
GRAND TOTAL				**$ 109,248,502**

Notes:

1. Estimate does not include ROW acquisition costs.
2. Quantity of bridges and grade crossings is taken from Springfield Terminal Railway Company track charts.
3. Bridge costs in this alternative represent costs to add second span adjacent to existing undergrade bridges to accommodate double-track. Existing undergrade bridges can not be modified to accommodate a second track. Overhead bridges are assumed to have the necessary horizontal clearance to accomodate a double-track section.
4. Unit costs for new rail equipment based on average prices included in MBTA North-South Rail Link MIS Update (escalated to $2004).
5. Upgrade Existing Public Grade Crossing cost includes modifying the existing crossings using existing equipment to accommodate two tracks.
6. Cost of clearing/grubbing and fine grading of subgrade is included in new track cost.
7. Station costs do not include grade separated pedestrian crossings.

Spaulding Turnpike Improvements - Transit Alternatives

Capital Costs

Rail/Fixed Guideway Alternative 1B: Expanded Downeaster Service (Rochester-Boston) *with double-tracking, with DMU equipment*				
Item	**Quantity**	**Unit**	**Unit Price**	**Total Price**
Infrastructure				
New Track	162,571	TF	$ 190	$ 30,888,528
New Interlocking	2	EA	$ 2,000,000	$ 4,000,000
Signals and Communications	162,571	LF	$ 90	$ 14,631,390
New U.G. Bridges (60' Span)	18	EA	$ 600,000	$ 10,800,000
Upgrade Existing Public Grade Crossing	16	EA	$ 175,000	$ 2,800,000
Grade Crossings - Private/Farm	7	EA	$ 50,000	$ 350,000
Layover Facility (2-450' Tracks)	1	LS	$ 1,323,000	$ 1,323,000
Rochester Station				
Canopy - 50'	1	LS	$ 50,000	$ 50,000
Platform	450	TF	$ 75	$ 33,750
Parking - 50 Spaces	12750	SF	$ 12	$ 153,000
Access	1	LS	$ 30,000	$ 30,000
Dover Station Renovations				
Parking - 50 Additional Spaces	12750	SF	$ 12	$ 153,000
Durham Station Renovations				
Parking - 50 Additional Spaces	12750	SF	$ 12	$ 153,000
Subtotal - Infrastructure				***$ 65,365,668***
Infrastructure Contingency	30%			$ 19,609,700
Design/Permitting/Construction Phase Services	20%			$ 13,073,134
Infrastructure Total with allowances				***$ 98,048,502***
Rail Equipment				
3-Car Diesel Multiple Unit Consist (292 seats)	1	EA	$7,500,000	$ 7,500,000
		EA		$ -
Equipment Total				***$ 7,500,000***
GRAND TOTAL				**$ 105,548,502**

Notes:

1. Estimate does not include ROW acquisition costs.
2. Quantity of bridges and grade crossings is taken from Springfield Terminal Railway Company track charts.
3. Bridge costs in this alternative represent costs to add second span adjacent to existing undergrade bridges to accommodate double-track. Existing undergrade bridges can not be modified to accommodate a second track. Overhead bridges are assumed to have the necessary horizontal clearance to accomodate a double-track section.
4. Unit costs for new rail equipment based on advertised costs for a three car diesel multiple unit set (April 2004)
5. Upgrade Existing Public Grade Crossing cost includes modifying the existing crossings using existing equipment to accommodate two tracks.
6. Cost of clearing/grubbing and fine grading of subgrade is included in new track cost.
7. Station costs do not include grade separated pedestrian crossings.

Spaulding Turnpike Improvements - Transit Alternatives

Capital Costs

Rail/Fixed Guideway Alternative 1B: Expanded Downeaster Service (Rochester-Boston) *without double-tracking, with traditional equipment*				
Item	**Quantity**	**Unit**	**Unit Price**	**Total Price**
Infrastructure				
New Track		TF	$ 190	$ -
New Interlocking		EA	$ 2,000,000	$ -
Signals and Communications		LF	$ 90	$ -
New U.G. Bridges (60' Span)		EA	$ 600,000	$ -
Upgrade Existing Public Grade Crossing		EA	$ 175,000	$ -
Grade Crossings - Private/Farm		EA	$ 50,000	$ -
Layover Facility (2-450' Tracks)	1	LS	$ 1,323,000	$ 1,323,000
Rochester Station				
Canopy - 50'	1	LS	$ 50,000	$ 50,000
Platform	450	TF	$ 75	$ 33,750
Parking - 50 Spaces	12750	SF	$ 12	$ 153,000
Access	1	LS	$ 30,000	$ 30,000
Dover Station Renovations				
Parking - 50 Additional Spaces	12750	SF	$ 12	$ 153,000
Durham Station Renovations				
Parking - 50 Additional Spaces	12750	SF	$ 12	$ 153,000
Subtotal - Infrastructure				***$ 1,895,750***
Infrastructure Contingency	30%			$ 568,725
Design/Permitting/Construction Phase Services	20%			$ 379,150
Infrastructure Total with allowances				***$ 2,843,625***
Rail Equipment				
Diesel locomotive	1	EA	$3,400,000	$ 3,400,000
Passenger coach	3	EA	$2,600,000	$ 7,800,000
Equipment Total				***$ 11,200,000***
GRAND TOTAL				**$ 14,043,625**

Notes:

1. Estimate does not include ROW acquisition costs.

2. Unit costs for new rail equipment based on average prices included in MBTA North-South Rail Link MIS Update (escalated to $2004).

3. Station costs do not include grade separated pedestrian crossings.

Spaulding Turnpike Improvements - Transit Alternatives

Capital Costs

Rail/Fixed Guideway Alternative 1B: Expanded Downeaster Service (Rochester-Boston) *without double-tracking, with DMU equipment*				
Item	**Quantity**	**Unit**	**Unit Price**	**Total Price**
Infrastructure				
New Track		TF	$ 190	$ -
New Interlocking		EA	$ 2,000,000	$ -
Signals and Communications		LF	$ 90	$ -
New U.G. Bridges (60' Span)		EA	$ 600,000	$ -
Upgrade Existing Public Grade Crossing		EA	$ 175,000	$ -
Grade Crossings - Private/Farm		EA	$ 50,000	$ -
Layover Facility (2-450' Tracks)	1	LS	$ 1,323,000	$ 1,323,000
Rochester Station				
Canopy - 50'	1	LS	$ 50,000	$ 50,000
Platform	450	TF	$ 75	$ 33,750
Parking - 50 Spaces	12750	SF	$ 12	$ 153,000
Access	1	LS	$ 30,000	$ 30,000
Dover Station Renovations				
Parking - 50 Additional Spaces	12750	SF	$ 12	$ 153,000
Durham Station Renovations				
Parking - 50 Additional Spaces	12750	SF	$ 12	$ 153,000
Subtotal - Infrastructure				***$ 1,895,750***
Infrastructure Contingency	30%			$ 568,725
Design/Permitting/Construction Phase Services	20%			$ 379,150
Infrastructure Total with allowances				***$ 2,843,625***
Rail Equipment				
3-Car Diesel Multiple Unit Consist (292 seats)	1	EA	$7,500,000	$ 7,500,000
		EA		$ -
Equipment Total				***$ 7,500,000***
GRAND TOTAL				**$ 10,343,625**

Notes:

1. Estimate does not include ROW acquisition costs.

2. Unit costs for new rail equipment based on advertised costs for a three car diesel multiple unit set (April 2004)

3. Station costs do not include grade separated pedestrian crossings.

Rail/Fixed Guideway Alternative 2A: Rochester-Portsmouth via Rockingham Junction (Commuter Rail)				
Item	**Quantity**	**Unit**	**Unit Price**	**Total Price**
Infrastructure				
New Track	110,187	TF	$ 190	$ 20,935,530
Turnouts - #20	6	EA	$ 190,000	$ 1,140,000
New Interlocking	2	EA	$ 2,000,000	$ 4,000,000
Signals and Communications	162,987	LF	$ 90	$ 14,668,830
New U.G. Bridges (60' Span)	12	EA	$ 600,000	$ 7,200,000
Upgrade Existing Grade Crossing	4	EA	$ 175,000	$ 700,000
Grade Crossing - Public	7	EA	$ 300,000	$ 2,100,000
Grade Crossing - Private/Farm	7	EA	$ 50,000	$ 350,000
Layover and S and I Facility (3-350' Tracks)	1	LS	$ 8,200,000	$ 8,200,000
Passing Siding - Track (2 - 1.5 mile sidings)	15,840	TF	$ 210	$ 3,326,400
Rochester Station				
Canopy - 50'	1	LS	$ 50,000	$ 50,000
Platform	450	TF	$ 75	$ 33,750
Parking - 50 Spaces	12750	SF	$ 12	$ 153,000
Access	1	LS	$ 30,000	$ 30,000
Somersworth Station				
Canopy - 50'	1	LS	$ 50,000	$ 50,000
Platform	450	TF	$ 75	$ 33,750
Parking - 50 Spaces	12750	SF	$ 12	$ 153,000
Access	1	LS	$ 30,000	$ 30,000
Dover Station Renovations				
Canopy - 50'	1	LS	$ 50,000	$ 50,000
Platform	450	TF	$ 75	$ 33,750
Parking - 50 Additional Spaces	12750	SF	$ 12	$ 153,000
Newmarket Station				
Canopy - 50'	1	LS	$ 50,000	$ 50,000
Platform	450	TF	$ 75	$ 33,750
Parking - 50 Spaces	12750	SF	$ 12	$ 153,000
Access	1	LS	$ 30,000	$ 30,000
Durham Station Renovations				
Canopy - 50'	1	LS	$ 50,000	$ 50,000
Platform	450	TF	$ 75	$ 33,750
Parking - 50 Additional Spaces	12750	SF	$ 12	$ 153,000
Portsmouth Transportation Center Station				
Canopy - 50'	1	LS	$ 50,000	$ 50,000
Platform	350	TF	$ 75	$ 26,250
Parking - 50 Spaces	12750	SF	$ 12	$ 153,000
Access	1	LS	$ 30,000	$ 30,000
Portsmouth Station				
Canopy - 50'	1	LS	$ 50,000	$ 50,000
Platform	350	TF	$ 75	$ 26,250
Parking - 50 Spaces	12750	SF	$ 12	$ 153,000
Access	1	LS	$ 30,000	$ 30,000
Subtotal - Infrastructure				***$ 64,413,010***
Infrastructure Contingency	30%			$ 19,323,903
Design/Permitting/Construction Phase Services	20%			$ 12,882,602
Infrastructure Total with allowances				***$ 96,619,515***
Rail Equipment				
Option 1: Traditional commuter rail equipment				
Diesel locomotive	4	EA	$3,400,000	$ 13,600,000
Passenger coach	12	EA	$2,600,000	$ 31,200,000
Option 2: Diesel Multiple Unit (DMU) equipment				
3-car DMU trainset	4	EA	$7,500,000	$ 30,000,000
Equipment Total (average of Options 1 and 2)				***$ 37,400,000***
GRAND TOTAL				**$ 134,019,515**

Spaulding Turnpike Improvements - Transit Alternatives
Capital Costs

Notes:

1. Estimate does not include ROW acquisition costs. Some land acquisition is expected to be required for the wye at Rockingham Junction.

2. Quantity of bridges and grade crossings on the Main Line West is taken from Springfield Terminal Railway Company track charts. Quantities on the Portsmouth Branch are taken from Rail and Transit Existing Conditions Report (October 2003).

3. Bridge costs in this alternative represent costs to replace existing single span undergrade structures on the Portsmouth Branch and to add a second span adjacent to existing undergrade bridges to accommodate double-track on the Main Line West. Existing undergrade bridges can not be modified to accommodate a second track.

4. Overhead bridges are assumed to have the necessary horizontal clearance to accomodate a double-track section.

5. Unit costs for new rail equipment based on an average of prices for conventional commuter rail equipment and DMU equipment. Average prices for conventional equipment from MBTA North-South Rail Link MIS Update (escalated to 2004$). Average price for DMU equipment from Colorado Railcar brochure, 2004.

6. Upgrade Existing Public Grade Crossing cost includes modifying the existing crossings using existing equipment to accommodate two tracks.

7. Cost of clearing/grubbing and fine grading of subgrade is included in new track cost.

8. Passing siding track cost includes new track cost and cost of roadbed construction.

9. Station costs do not include grade separated pedestrian crossings.

Spaulding Turnpike Improvements - Transit Alternatives

Capital Costs

Rail/Fixed Guideway Alternative 2B: Rochester-Portsmouth via Turnpike Corridor (Commuter Rail)				
Item	**Quantity**	**Unit**	**Unit Price**	**Total Price**
Infrastructure				
New Track	33,162	TF	$ 190	$ 6,300,780
New Track and Embankment	22,369	TF	$ 210	$ 4,697,490
Turnouts - #20	5	TF	$ 190,000	$ 950,000
New Interlocking	0	EA	$ 2,000,000	$ -
Signals and Communications	108,331	TF	$ 90	$ 9,749,790
Retaining Walls	33,162	LF	$ 350	$ 11,606,700
Bridges				
Little Bay Crossing (1630' Span)	1	LS	$ 16,300,000	$ 16,300,000
Pomeroy Cove Crossing (850' Span)	1	LS	$ 8,500,000	$ 8,500,000
New U.G. Bridges (60' Span)	11	EA	$ 600,000	$ 6,600,000
Fence	33,162	LF	$ 12	$ 397,944
Grade Crossings - Public	5	EA	$ 300,000	$ 1,500,000
Grade Crossings - Private	9	EA	$ 50,000	$ 450,000
Storage and Inspection Facility (3-350' Tracks)	1	LS	$ 8,200,000	$ 8,200,000
Passing Siding - Track (2 - 1.5 mile sidings)	15,840	TF	$ 210	$ 3,326,400
Rochester Station				
Canopy - 50'	1	LS	$ 50,000	$ 50,000
Platform	350	TF	$ 75	$ 26,250
Parking - 50 Spaces	12750	SF	$ 12	$ 153,000
Access	1	LS	$ 30,000	$ 30,000
Somersworth Station				
Canopy - 50'	1	LS	$ 50,000	$ 50,000
Platform	350	TF	$ 75	$ 26,250
Parking - 50 Spaces	12750	SF	$ 12	$ 153,000
Access	1	LS	$ 30,000	$ 30,000
Dover Station Renovations				
Canopy - 50'	1	LS	$ 50,000	$ 50,000
Platform	350	TF	$ 75	$ 26,250
Parking - 50 Additional Spaces	12750	SF	$ 12	$ 153,000
Exit 1 (Gosling Road) Station				
Canopy - 50'	1	LS	$ 50,000	$ 50,000
Platform	350	TF	$ 75	$ 26,250
Parking - 50 Spaces	12750	SF	$ 12	$ 153,000
Access	1	LS	$ 30,000	$ 30,000
Portsmouth Station				
Canopy - 50'	1	LS	$ 50,000	$ 50,000
Platform	350	TF	$ 75	$ 26,250
Parking - 50 Spaces	12750	SF	$ 12	$ 153,000
Access	1	LS	$ 30,000	$ 30,000
Subtotal - Infrastructure				***$ 79,845,354***
Infrastructure Contingency	30%			$ 23,953,606
Design/Permitting/Construction Phase Services	20%			$ 15,969,071
Infrastructure Total with allowances				***$ 119,768,031***
Rail Equipment				
Option 1: Traditional commuter rail equipment				
Diesel locomotive	4	EA	$3,400,000	$ 13,600,000
Passenger coach	12	EA	$2,600,000	$ 31,200,000
Option 2: Diesel Multiple Unit (DMU) equipment				
3-car DMU trainset	4	EA	$7,500,000	$ 30,000,000
Equipment Total (average of Options 1 and 2)				***$ 37,400,000***
GRAND TOTAL				**$ 157,168,031**

Notes:

1. Estimate does not include ROW acquisition costs. Some land acquisition is expected to be required for the wye track between the Sawyer's Branch and the Main Line West.

2. Quantity of bridges and grade crossings is taken from Rail and Transit Existing Conditions Report (October 2003).

3. Bridge costs in this alternative represent costs to construct new bridge structures on the Sawyer and Dover Branches and replace existing undergrade bridges on the Newington Branch.

4. Unit costs for new rail equipment based on an average of prices for conventional commuter rail equipment and DMU equipment. Average prices for conventional equipment from MBTA North-South Rail Link MIS Update (escalated to 2004$). Average price for DMU equipment from Colorado Railcar brochure, 2004.

Spaulding Turnpike Improvements - Transit Alternatives

Capital Costs

Rail/Fixed Guideway Alternative 2B: Rochester-Portsmouth via Turnpike Corridor (LRT)				
Item	**Quantity**	**Unit**	**Unit Price**	**Total Price**
Infrastructure				
New Track and Embankment	122587	TF	$ 210	$ 25,743,270
Turnouts - #20	4	EA	$ 250,000	$ 1,000,000
New Interlocking	0	EA	$ 2,000,000	$ -
Bridges				
Little Bay Crossing (1630' Span)	1	LS	$ 16,300,000	$ 16,300,000
Pomeroy Cove Crossing (850' Span)	1	LS	$ 8,500,000	$ 8,500,000
North Mill Pond (1700' Span)	1	LS	$ 17,000,000	$ 17,000,000
New Bridges (60' Span)	23	EA	$ 600,000	$ 13,800,000
West Main Line Flyover	1	LS	$ 12,530,000	$ 12,530,000
Retaining Wall	33,162	LF	$ 350	$ 11,606,700
Concrete Barrier	22,369	TF	$ 320	$ 7,158,080
Fence	55,531	LF	$ 12	$ 666,372
Grade Crossings - Public	19	EA	$ 300,000	$ 5,700,000
Grade Crossings - Private	13	EA	$ 50,000	$ 650,000
Layover and S and I Facility	1	LS	$ 8,200,000	$ 8,200,000
Passing Siding - Track (2 - 1.5 mile sidings)	15,840	TF	$ 210	$ 3,326,400
Rochester Station				
Canopy - 50'	1	LS	$ 50,000	$ 50,000
Platform	350	TF	$ 75	$ 26,250
Parking - 50 Spaces	12750	SF	$ 12	$ 153,000
Access	1	LS	$ 30,000	$ 30,000
Somersworth Station				
Canopy - 50'	1	LS	$ 50,000	$ 50,000
Platform	350	TF	$ 75	$ 26,250
Parking - 50 Spaces	12750	SF	$ 12	$ 153,000
Access	1	LS	$ 30,000	$ 30,000
Dover Station Renovations				
Canopy - 50'	1	LS	$ 50,000	$ 18,000
Platform	350	TF	$ 75	$ 26,250
Parking - 50 Additional Spaces	12750	SF	$ 12	$ 153,000
Exit 1 (Gosling Road) Station				
Canopy - 50'	1	LS	$ 50,000	$ 18,000
Platform	350	TF	$ 75	$ 26,250
Parking - 50 Spaces	12750	SF	$ 12	$ 153,000
Access	1	LS	$ 30,000	$ 30,000
Portsmouth Station				
Canopy - 50'	1	LS	$ 50,000	$ 18,000
Platform	350	TF	$ 75	$ 26,250
Parking - 50 Spaces	12750	SF	$ 12	$ 153,000
Access	1	LS	$ 30,000	$ 30,000
Subtotal - Infrastructure				***$ 133,351,072***
Infrastructure Contingency	30%			$ 40,005,322
Design/Permitting/Construction Phase Services	20%			$ 26,670,214
Infrastructure Total with allowances				***$ 200,026,608***
Rail Equipment				
Self-propelled Diesel Light Rail Vehicle	12	EA	$3,400,000	$ 40,800,000
Equipment Total				***$ 40,800,000***
GRAND TOTAL				**$ 240,826,608**

Notes:

1. Estimate does not include ROW acquisition costs. Some land acquisition is expected to be required for the wye track between the Sawyer's Branch and the Main Line West.
2. Quantity of bridges and grade crossings is taken from Rail and Transit Existing Conditions Report (October 2003).
3. Bridge costs in this alternative represent costs to construct new bridge structures on the Sawyer and Dover Branches and replace existing undergrade bridges on the Newington Branch.
4. Unit cost of self-propelled LRT equipment based on NJ Transit River Line (Southern New Jersey) system purchase (quoted in NH I-93 Rail Alterantives Evaluation Report).
5. Cost of clearing and grubbing, fine grading, subballast, ties and rail are included in the New Track cost.
6. The cost to construct roadbed are included in the cost of New Track and Embankment.
7. Public Grade Crossing cost includes the full cost of a new signalized crossing.
8. Station costs do not include grade separated pedestrian crossings.

Spaulding Turnpike Improvements - Transit Alternatives

Capital Costs

Rail/Fixed Guideway Alternative 2B: Rochester-Portsmouth via Turnpike Corridor (BRT)				
Item	**Quantity**	**Unit**	**Unit Price**	**Total Price**
Infrastructure				
Guideway (20' Roadway)	122587	LF	$ 150	$ 18,388,050
Bridges				
Little Bay Crossing	1	LS	$ 16,300,000	$ 16,300,000
Pomeroy Cove Crossing (850' Span)	1	LS	$ 8,500,000	$ 8,500,000
North Mill Pond (1700' Span)	1	LS	$ 17,000,000	$ 17,000,000
New Bridges (60' Span)	23	EA	$ 600,000	$ 13,800,000
Main Line West Flyover	1	LS	$ 11,098,000	$ 11,098,000
Retaining Wall	33,162	LF	$ 350	$ 11,606,700
Concrete Barrier	22,369	LF	$ 320	$ 7,158,080
Fence	55,531	LF	$ 12	$ 666,372
Grade Crossings - Public	19	EA	$ 300,000	$ 5,700,000
Grade Crossings - Private	13	EA	$ 50,000	$ 650,000
Bus Turnaround	2	EA	$ 10,000	$ 20,000
Storage and Maintenance Facility	1	LS	$ 1,887,153	$ 1,887,153
Passing Lane (2 - 1.5 mile siding)	15,840	LF	$ 150	$ 2,376,000
Rochester Station				
Bus Shelter	1	LS	$ 30,000	$ 30,000
Turnout	1	LS	$ 5,000	$ 5,000
Parking - 50 Spaces	12750	SF	$ 12	$ 153,000
Access	1	LS	$ 30,000	$ 30,000
Somersworth Station				
Bus Shelter	1	LS	$ 30,000	$ 30,000
Turnout	1	LS	$ 5,000	$ 5,000
Parking - 50 Spaces	12750	SF	$ 12	$ 153,000
Access	1	LS	$ 30,000	$ 30,000
Dover Station Renovations				
Bus Shelter	1	LS	$ 30,000	$ 30,000
Turnout	1	LS	$ 5,000	$ 5,000
Parking - 50 Additional Spaces	12750	SF	$ 12	$ 153,000
Exit 1 (Gosling Road) Station				
Bus Shelter	1	LS	$ 30,000	$ 30,000
Turnout	1	LS	$ 5,000	$ 5,000
Parking - 50 Spaces	12750	SF	$ 12	$ 153,000
Access	1	LS	$ 30,000	$ 30,000
Portsmouth Station				
Bus Shelter	1	LS	$ 30,000	$ 30,000
Turnout	1	LS	$ 5,000	$ 5,000
Parking - 50 Spaces	12750	SF	$ 12	$ 153,000
Access	1	LS	$ 30,000	$ 30,000
Subtotal - Infrastructure				***$ 116,210,355***
Infrastructure Contingency	30%			$ 34,863,107
Design/Permitting/Construction Phase Services	20%			$ 23,242,071
Infrastructure Total with allowances				***$ 174,315,533***
Equipment				
Articulated Bus	4	EA	$515,889	$ 2,063,556
Equipment Total				***$ 2,063,556***
GRAND TOTAL				**$ 176,379,089**

Notes:

1. Estimate does not include ROW acquisition costs. Some land acquisition is expected to be required for the wye track between the Sawyer's Branch and the Main Line West.
2. Quantity of bridges and grade crossings is taken from Rail and Transit Existing Conditions Report (October 2003).
3. Bridge costs in this alternative represent costs to construct new bridge structures on the Sawyer and Dover Branches and replace existing undergrade bridges on the Newington Branch.
4. Unit costs for new articulated buses based on U.S. New Vehicle Costs for 2001 and 2002 Vehicles, 2002 APTA Vehicle Survey. Unit cost has been escalated by 3.5% per year to bring to 2004 dollars.
5. Cost of clearing and grubbing, fine grading, subballast, ties and rail are included in the New Track cost.
6. The cost to construct roadbed are included in the cost of New Track and Embankment.
7. Public Grade Crossing cost includes the full cost of a new signalized crossing.
8. Station costs do not include grade separated pedestrian crossings.
9. BRT storage and maintenance faciltiy cost estimate is detailed in separate sheet.

Spaulding Turnpike Improvements - Transit Alternatives

Capital Costs

Layover/Maintenance Facility Estimate Rail/Fixed Guideway Alternative 2B - Rochester - Portsmouth via Turnpike Corridor (BRT)				
Item	**Quantity**	**Unit**	**Unit Price**	**Total Price**
Bus Storage				
Building - New Construction	5,880	SF	$ 77	$ 450,996
Subtotal - Bus Storage				***$ 450,996***
Bus Maintenance				
Building - New Construction	3,200	SF	$ 109	$ 349,440
Maintenance Bay Equipment	2	EA	$ 84,500	$ 169,000
Misc. Shops Equipment	1	LS	$ 50,000	$ 50,000
Subtotal - Bus Maintenance				***$ 568,440***
Daily Service				
Building - New Construction	1,600	SF	$ 59	$ 93,600
Fuel Service Equipment	1	LS	$ 150,000	$ 150,000
Misc. Equipment	1	LS	$ 133,333	$ 133,333
Subtotal - Daily Service				***$ 376,933***
Admin. & Transp. Services				
Building - New Construction	1,552	SF	$ 137	$ 211,848
Subtotal - Admin. & Transp. Services				***$ 211,848***
Employee Parking				
Surface lot	10	space	$ 3,500	$ 35,000
Subtotal - Employee Parking				***$ 35,000***
Site Costs				
New Utilities	250	LF	$ 200	$ 50,000
Paving (80% site)	34,848	LF	$ 7	$ 243,936
Subtotal - Employee Parking				***$ 243,936***
Subtotal				***$ 1,887,153***
Contingency	30%			$ 566,146
Design/Permitting/Construction Phase Services	20%			$ 377,431
Total with allowances				***$ 2,830,730***
GRAND TOTAL				**$ 2,830,730**

Notes:

1. Estimate does not include land acquisition cost.
2. Sizing assumes a fleet of 3 active buses, 1 spare buses at start of service, with room for 50% expansion (2 additior

Spaulding Turnpike Improvements - Transit Alternatives

Capital Costs

Rail/Fixed Guideway Alternative 3: Conway Branch				
Item	**Quantity**	**Unit**	**Unit Price**	**Total Price**
Infrastructure				
Upgrade Track from Class II to IV	116,160	TF	$ 60	$ 6,969,600
New Interlocking	0	EA	$ 2,000,000	$ -
Signals and Communications	0	LF	$ 90	$ -
Bridges	0	EA	$ 1,500,000	$ -
Crossings	0	EA	$ 300,000	$ -
Dover Station Renovations				
Canopy - 50'	1	LS	$ 50,000	$ 50,000
Platform	450	TF	$ 75	$ 33,750
Parking - 50 Additional Spaces	12750	SF	$ 12	$ 153,000
5 New Stations				
Platform	2250	TF	$ 75	$ 168,750
Parking - 50 Spaces	63750	SF	$ 12	$ 765,000
Access	5	EA	$ 30,000	$ 150,000
Subtotal				***$ 8,140,100***
Infrastructure Contingency	30%			$ 2,442,030
Design/Permitting/Construction Phase Services	20%			$ 1,628,020
Infrastructure Total with allowances				***$ 12,210,150***
Rail Equipment				
3-Car Diesel Multiple Unit Consist (292 seats)	1	EA	$7,500,000	$ 7,500,000
		EA		$ -
Equipment Total				***$ 7,500,000***
GRAND TOTAL - Rail/Fixed Guideway Alternative 3				**$ 19,710,150**
Initial Work Identified in Conway Branch Feasibility Study				
Rehabilitate Track to Class I (NHDOT Phases 1 and 2)	1	LS	$ 7,493,500	$ 7,493,500
Upgrade Track from Class I to II (NHDOT Phase 3)	1	LS	$ 11,000,000	$ 11,000,000
GRAND TOTAL				**$ 38,203,650**

Notes:

1.Track upgrade costs all refer to the 22-mile track section of out-of-service track between Ossipee and Conway.

2. Work associated with rehabilitating the 22-mile segment to Class I and Class II standards is described in June 2004 NHDOT Conway Branch Feasibility Study. Cost of upgrade is from Feasibility Study. Upgrade to Class II is assumed to take place separately from restoration/opening of branch (Phase 1 and 2 work).

3. Cost to upgrade track from Class II to Class IV includes cost to increase # ties to spacing sufficient for Class IV, and cost to resurface and align existing track. Upgrade to Class IV is assumed to take place separately from Class II upgrade.

4. Cost of upgrade from Class II to Class IV is based both on calculation of tie replacement and resurface and realign, and based on a comparison to the total track-foot cost used in other estimates in this study. Other estimates assume $190/TF to restore existing freight (marginal Class I) to Class IV. NHDOT estimate to restore to Class I works out to about $4,000,000, or about $35/TF.(April draft memo). Cost to restore to Class II, $11,000,000, works out to about $95/TF (Kit Morgan, June 2004). Remainder to get to class IV is estimated at $60, or $190-$95-$35.

5. Estimate assumes that no additional bridge or grade crossing work beyond that identified in NHDOT study is required.

6. Unit costs for new rail equipment based on advertised costs for a three car diesel multiple unit set (April 2004)

Spaulding Turnpike Improvements - Transit Alternatives

Capital Costs

Rail/Fixed Guideway Alternative 4 Restoration of Pease Spur for Freight Rail Services				
LOW END ESTIMATE **Item**	**Quantity**	**Unit**	**Unit Price**	**Total Price**
Infrastructure				
New Track	2,000	TF	$ 145	$ 290,000
Turnout	1	EA	$ 250,000	$ 250,000
Bridges	0	EA	$ 600,000	$ -
Grade Crossings	1	EA	$ 300,000	$ 300,000
Subtotal				***$ 840,000***
Infrastructure Contingency	30%			$ 252,000
Design/Permitting/Construction Phase Services	20%			$ 168,000
Infrastructure Total with allowances				***$ 1,260,000***
GRAND TOTAL - LOW END ESTIMATE				**$ 1,260,000**
HIGH END ESTIMATE **Item**	**Quantity**	**Unit**	**Unit Price**	**Total Price**
Infrastructure				
New Track	2,800	TF	$ 145	$ 406,000
Turnout	1	EA	$ 250,000	$ 250,000
Bridges	0	EA	$ 600,000	$ -
Grade Crossings	2	EA	$ 300,000	$ 600,000
Subtotal				***$ 1,256,000***
Infrastructure Contingency	30%			$ 376,800
Design/Permitting/Construction Phase Services	20%			$ 251,200
Infrastructure Total with allowances				***$ 1,884,000***
GRAND TOTAL - HIGH END ESTIMATE				**$ 1,884,000**

Notes:

1. This estimate does not include the cost of grade separation of the Spaulding Turnpike from the spur, or the earthwork necessary to provide the rail roadbed. These costs are included in the cost estimates for the highway alternatives.

2. This estimate only includes costs of rail infrastructure from the Newington Branch to the existing spur on Pease property. It is assumed that any costs of rail reconstruction within the Tradeport (outside the limits of the rail relocation) would be borne by others.

3. The Low End and High End estimates are developed to represent the range of track costs and grade crossing costs in the six roadway alternatives being considered in July 2004 (Newington Alts 6,7,9,10,11,12).

Park-and-Rides: Conceptual Cost Estimates
(applies to proposed Rochester, Dover and Durham facilities)

Cost of Site Work

Site work is assumed to include access roadway improvements, park-and-ride pavement, earthwork, and other related infrastructure (e.g., signalized intersections, retaining walls).

The cost of site work for the Newington-Dover Park-and-Rides has been estimated based on the number of spaces in the proposed Park-and-Rides and the average cost per space of site work for the I-93 NH Park-and-Ride alternatives.

Average Cost of Site Work for NH I-93 Park-and-Rides

Exit/Alternative	Capital Cost w/o structures and contingencies	Number of spaces	Capital cost per space
Exit 2	$ 1,296,996	430	$ 3,016
Exit 3/Tight Diamond	$ 3,350,263	525	$ 6,381
Exit 3/NB Shift	$ 2,559,218	525	$ 4,875
Exit 5/NW Quad	$ 1,103,387	600	$ 1,839
Exit 5/Perkins Road	$ 3,823,240	700	$ 5,462
Exit 5/Auburn Road	$ 1,120,573	500	$ 2,241
Exit 5/Sunoco	$ 798,249	525	$ 1,520
Exit 5/Cycle World	$ 1,020,034	480	$ 2,125
Average of all sites			**$ 3,432**

Cost of Building and Amenities

This cost is assumed to include a small passenger building, restrooms, lighting, benches, and overhang over bus bays.

The starting point for this cost estimate was a conceptual cost figure of $800,000 for buildings and amenities at the Concord Park-and-Ride facility.
This $800,000 figure assumes a building of approximately 60' x 50', or 3000 square feet. For the Newington-Dover Park-and-Rides, smaller buildings (25' x 40', 1000 square feet) have been assumed.
The $800,000 figure has been scaled down for the smaller building size. A factor of 25% has been used to reflect the fact that there are many fixed costs (e.g., restrooms, utilities) that will not vary much by building size.
This produces a conceptual cost of **$ 325,000** per location.

A 30% contingency for unknowns and a 20% allowance for survey/design/construction phase services has been assumed to reflect the conceptual level of the estimate.

The following table shows the conceptual cost estimate for a Newington-Dover Park-and-Ride facility (300 spaces).

Item	Quantity	Unit	Unit Price	Total Price
Infrastructure				
Site Work	280	space	$ 3,432	$ 961,095
Buildings and Amenities	1	LS	$ 325,000	$ 325,000
				$ -
Subtotal				***$ 1,286,095***
Infrastructure Contingency	30%			$ 385,829
Design/Permitting/Construction Phase Services	20%			$ 257,219
Infrastructure Total with allowances				***$ 1,929,143***
GRAND TOTAL				**$ 2,000,000**

Spaulding Turnpike Improvements - Transit Alternatives

Capital Costs

Bus Alternative 1: Expanded Intercity Service (Rochester-Boston)				
Item	**Quantity**	**Unit**	**Unit Price**	**Total Price**
Infrastructure				
Rochester Park-and-Ride facility (300 spaces)	1	LS	$ 1,286,095	$ 1,286,095
Dover Park-and-Ride facility (300 spaces)	1	LS	$ 1,286,095	$ 1,286,095
Subtotal - Infrastructure				***$ 2,572,191***
Infrastructure Contingency	30%			$ 771,657
Design/Permitting/Construction Phase Services	20%			$ 514,438
Infrastructure Total with allowances				***$ 3,858,286***
Equipment				
Intercity Coach Bus	7	EA	$427,419	$ 2,991,931
Equipment Total				***$ 2,991,931***
GRAND TOTAL				**$ 6,850,217**

Notes:

1. Estimate does not include ROW acquisition costs.
2. Park-and-Ride facility cost estimate is detailed in separate sheet.
3. Unit costs for new intercity coach-style buses based on U.S. New Vehicle Costs for 2001 and 2002 Vehicles, 2002 APTA Vehicle Survey. Unit cost has been escalated by 3.5% per year to bring to 2004 dollars.

Spaulding Turnpike Improvements - Transit Alternatives

Capital Costs

Bus Alternative 2: Expanded Express Service (Rochester-Portsmouth Transportation Center)				
Item	**Quantity**	**Unit**	**Unit Price**	**Total Price**
Infrastructure				
Rochester Park-and-Ride facility (300 spaces)	1	LS	$ 1,286,095	$ 1,286,095
Dover Park-and-Ride facility (300 spaces)	1	LS	$ 1,286,095	$ 1,286,095
Subtotal - Infrastructure				***$ 2,572,191***
Infrastructure Contingency	30%			$ 771,657
Design/Permitting/Construction Phase Services	20%			$ 514,438
Infrastructure Total with allowances				***$ 3,858,286***
Equipment				
Transit Bus	1	EA	$337,436	$ 337,436
Equipment Total				***$ 337,436***
GRAND TOTAL				**$ 4,195,722**

Notes:

1. Estimate does not include ROW acquisition costs.
2. Park-and-Ride facility cost estimate is detailed in separate sheet.
3. Unit cost for new transit buses based on U.S. New Vehicle Costs for 2001 and 2002 Vehicles, 2002 APTA Vehicle Survey. Unit cost has been escalated by 3.5% per year to bring to 2004 dollars.

Spaulding Turnpike Improvements - Transit Alternatives

Capital Costs

Bus Alternative 3: Expanded Local Service				
Item	**Quantity**	**Unit**	**Unit Price**	**Total Price**
Infrastructure				
Rochester Park-and-Ride facility (300 spaces)	1	LS	$ 1,286,095	$ 1,286,095
Durham Park-and-Ride facility (300 spaces)	1	LS	$ 1,286,095	$ 1,286,095
Exit 1/Gosling Road transfer point	1	LS	$ 341,667	$ 341,667
Subtotal - Infrastructure				***$ 2,913,857***
Infrastructure Contingency	30%			$ 874,157
Design/Permitting/Construction Phase Services	20%			$ 582,771
Infrastructure Total with allowances				***$ 4,370,786***
Equipment				
Transit Bus	2	EA	$337,436	$ 674,872
Replica Trolley Bus	1	EA	$307,977	$ 307,977
Equipment Total				***$ 982,849***
GRAND TOTAL				**$ 5,353,635**

Notes:

1. Estimate does not include ROW acquisition costs.
2. Park-and-Ride facility cost estimate is detailed in separate sheet.
3. Cost of infrastructure improvements at Exit 1/Gosling Road transfer point are detailed in separate sheet.
4. Unit costs for new transit buses and replica trolley buses based on U.S. New Vehicle Costs for 2001 and 2002 Vehicles, 2002 APTA Vehicle Survey. Unit cost has been escalated by 3.5% per year to bring to 2004 dollars.

Spaulding Turnpike Improvements - Transit Alternatives

Capital Costs

Exit 1/Gosling Road Bus Transfer Point				
Item	**Quantity**	**Unit**	**Unit Price**	**Total Price**
Infrastructure				
Shelter	4	EA	$ 30,000	$ 120,000
Turnout	4	EA	$ 20,000	$ 80,000
6' Cem. Conc. Sidewalk	333	SY	$ 35	$ 11,667
Lighting	26	EA	$ 5,000	$ 130,000
				$ -
Subtotal				***$ 341,667***
Infrastructure Contingency	30%			$ 102,500
Design/Permitting/Construction Phase Services	20%			$ 68,333
Infrastructure Total with allowances				***$ 512,500***
GRAND TOTAL				**$ 520,000**

Notes:

1. Estimate does not include ROW acquisition costs.

2. Estimate assumes infrastructure improvements at two sides of the Spaulding Turnpike/Gosling Rd interchange: the NW and the SE quadrants.

Spaulding Turnpike Improvements - Transit Alternatives

Capital Costs

Bus Alternative Package: All Services				
Item	**Quantity**	**Unit**	**Unit Price**	**Total Price**
Infrastructure				
Rochester Park-and-Ride facility (300 spaces)	1	LS	$ 1,286,095	$ 1,286,095
Dover Park-and-Ride facility (300 spaces)	1	LS	$ 1,286,095	$ 1,286,095
Durham Park-and-Ride facility (300 spaces)	1	LS	$ 1,286,095	$ 1,286,095
Exit 1/Gosling Road transfer point	1	LS	$ 341,667	$ 341,667
Subtotal - Infrastructure				***$ 4,199,952***
Infrastructure Contingency	30%			$ 1,259,986
Design/Permitting/Construction Phase Services	20%			$ 839,990
Infrastructure Total with allowances				***$ 6,299,929***
Equipment				
Intercity Coach Bus	7	EA	$427,419	$ 2,991,931
Transit Bus	3	EA	$337,436	$ 1,012,308
Replica Trolley Bus	1	EA	$307,977	$ 307,977
Equipment Total				***$ 4,312,216***
GRAND TOTAL				**$ 10,612,145**

Notes:

1. Estimate does not include ROW acquisition costs.
2. Park-and-Ride facility cost estimate is detailed in separate sheet.
3. Cost of infrastructure improvements at Exit 1/Gosling Road transfer point are detailed in separate sheet.
4. Unit costs for new intercity coach buses, transit buses and replica trolley buses based on U.S. New Vehicle Costs for 2001 and 2002 Vehicles, 2002 APTA Vehicle Survey. Unit cost has been escalated by 3.5% per year to bring to 2004 dollars.

Appendix C — RSG Memorandum

R|S|G INC.
RESOURCE SYSTEMS GROUP, INC.

MEMORANDUM

To: Robin Bousa and Frank O'Callaghan
From: Nicole Buck and Stephen Lawe
Subject: 2025 Land Use Assumptions and Travel Demand Model Modifications
Date: 4 January 2005

Upon review of the initial travel demand model results developed for the US Route 1 Bypass Study, the Rockingham Planning Commission (RPC), City of Portsmouth, New Hampshire Department of Transportation (NHDOT), and Resource Systems Group (RSG) determined that the original land use assumptions developed by the RPC and municipal officials required re-examination. The initial travel demand predictions raised questions as to the nature, scale, location and schedule of forecasted land use changes. For example, the initial land use assumptions resulted in an average annual employment growth rate at the Pease Tradeport that is nearly four times the overall regional employment growth rate for the 2010-2020 time period (based on NH Employment Security Projections). Whereas, conversely, the initial land use assumptions resulted in no growth (and in some areas negative growth) for downtown Portsmouth. Based on the somewhat unrealistic results from the initial model, the land use assumptions were re-examined and modified. The revised land use assumptions have been deemed more reasonable and affect travel demand forecasts for both the US Route 1 Bypass and Newington-Dover projects.

Revising the land use assumptions and updating of the travel demand model afforded the opportunity to standardize the peak shifting and spreading methodologies, which have evolved throughout the project. The intent of this memorandum is to provide a general description of the changes made to the land use assumptions, to describe the peak shifting and spreading methodologies, and to summarize the model results as related to these items. A more detailed summary of this information is provided in Resource System's Group's (RSG) January 3, 2005 Memorandum titled "2025 Peak Shifting Methodology.

CHANGE IN LAND USE ASSUMPTIONS REFLECTED IN THE SCOPING REPORT (MARCH 2004) AND THE RATIONALE REPORT (JANUARY 2005)

After the Newington-Dover Scoping Report was completed, RSG began work on the Route 1 Bypass project using the same regional travel demand model. As stated above, the preliminary travel demand predictions for the Route 1 Bypass work caused a reassessment of the land use assumptions that went into the future model years for the US Route 1 Bypass and Newington-Dover projects. There were three changes that were made as a result of this reassessment:

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- In the Scoping Report, it was assumed that Pease would reach full build out by the year 2025. In the Rationale Report, Pease full build out is assumed to occur after 2025. This assumption was changed in an effort to bring Pease's growth assumptions more into alignment with regional growth assumptions. Therefore there are 25% fewer Pease employees represented in the Rationale Report's traffic volumes than in the Scoping Report's traffic volumes.
- The initial land use assumptions included no land available for housing in the downtown Portsmouth area, since the area has been fully built out. The Rationale Report reflects a more reasonable assumption that some of the existing land in the downtown area would be redeveloped. Therefore, there is an increase in the amount of land available for housing in the future years in the downtown between the Scoping Report and the Rationale Report. This results in a minor increase in vehicle trips to and from the downtown.
- In the Scoping Report, it was assumed that all roadways external to the model grew at the same rate. The revised assumptions incorporated into the Rationale Report include differing growth rates for each external region (New Hampshire, Maine, and Massachusetts). The external growth rates were revised based on regional data that suggests that travel between Massachusetts and the model region and Maine and the model region was going to grow at a much slower rate than travel between the model region and the rest of New Hampshire. The external growth rates were modified to reflect that trend.

The RPC, City of Portsmouth, NHDOT, and the PDA felt that the revised assumptions regarding the region's future land use used to generate the traffic volumes in the Rationale Report provide a more reasonable estimation of future conditions.

PEAK SHIFTING

Peak shifting occurs when motorists choose to travel at a different time of day outside the peak hours to avoid congestion. The initial future year model runs (performed in January, 2004) did not include peak shifting and showed a reduction in trips on some of the study area roadways as a result of excessive delay. This did not represent a realistic picture of future traffic flow. These results made RSG realize that the projected growth in the area could not be processed by one peak hour and that additional peak shifting would have to occur in order to process the traffic forecasted as a result of regional growth assumptions. Our peak shifting model involves removing those trips that are excessively delayed from the peak hour and assumes that those trips will occur on the peak's shoulder hours. RSG believes peak shifting allows us to more realistically represent future traffic flows.

Original Methodology

The initial peak shifting methodology involved performing a "partially constrained" model run to estimate the demand for the roads. This was modeled by increasing the roadway capacity region-wide. A regression model based on hourly permanent count data in the area helped determine the number of trips occurring during the peak and off peak hours. Volumes were balanced and distributed using the partially constrained assignment and the information from the regression model. Peak shifting was only applied to study area roads where the volume-to-capacity ratio suggested extreme delays.

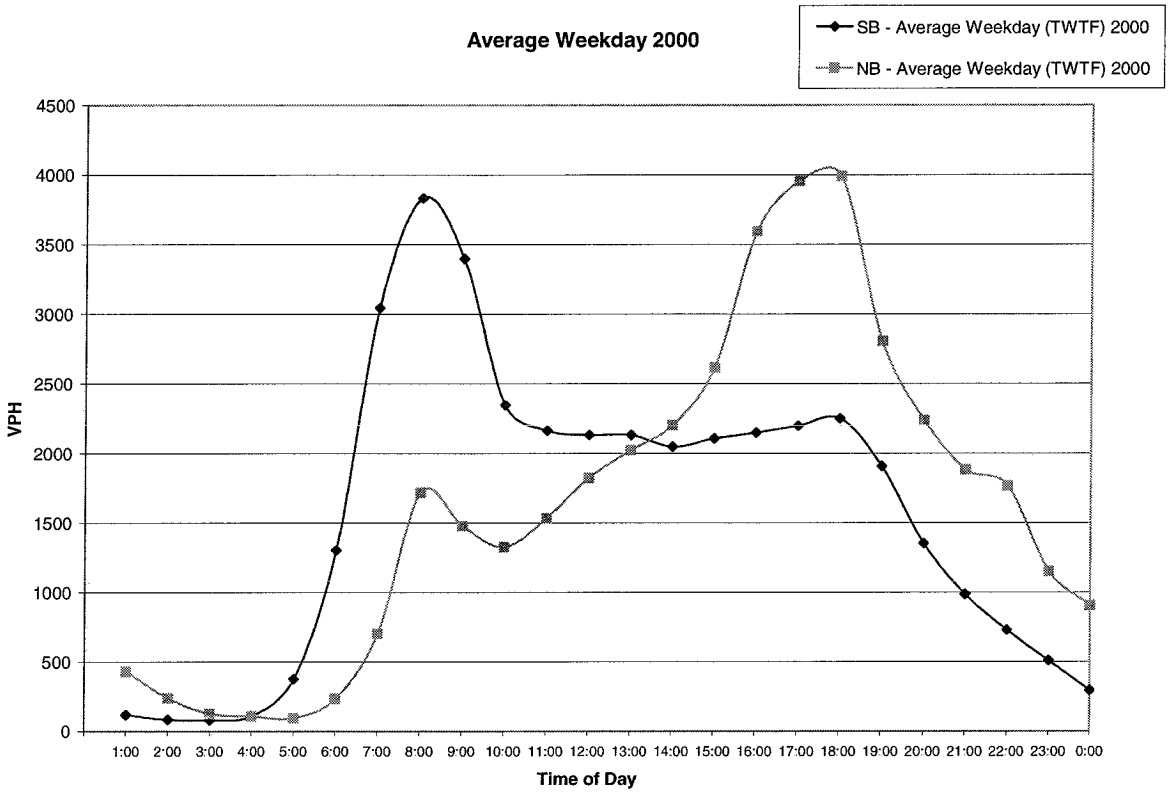
This method of peak shifting is similar to peak shifting methods used in the Intercounty Connector project between Washington and Baltimore and is a good methodology for projects like the Newington-Dover project. However, the congestion forecasted by the model extends region-wide and does not just include the Newington-Dover project area. With the revision to the land use assumptions, the opportunity was seized to improve upon the peak shifting methodology.

Revised Methodology

The revised peak shifting is modeled on a method currently being developed for the Tampa Florida regional network model. Where the previous method was implemented entirely outside the model (post model peak shifting), this method is incorporated into the assignment portion of the model and involves iterating between assignment and peak shifting.

Figure 1 shows the 2000 average annual weekday hourly volumes on the Spaulding Turnpike at the Little Bay Brides for the northbound and southbound directions. As shown, the Turnpike volume in the northbound direction suggests peak shifting is beginning to occur during the PM peak hour. Peak spreading is actually more noticeable and distinct when reviewing data from the peak months (compared the average annual condition). Using the 2000 free flow travel time (uncongested travel time) and the congested travel time, we were able to estimate the point at which people were likely to shift to another time period. This is an iterative process that removes trips that would likely shift to an off-peak hour or shoulder hour as a result of the level of congestion on the Turnpike and other roadways.

Figure 1: June 2000 Bi-directional Average Weekday Flow on the Little Bay Bridges



The primary benefit of this new peak shifting method is that the spread is performed network-wide and not on a specific corridor. Therefore route diversion, as well as peak shifting, can be better assessed and demonstrated. The revised peak shifting method allows the demand on specific roadways to exceed the capacity of those roadways. This is because the peak shifting method only shifts those trips which have excessive delays. Therefore, when the demand exceeds the capacity queuing (or peak spreading) occurs followed by peak shifting.

Peak Shifting Results

Table 1 shows the results of the peak shifting process for each of the three Build scenarios being considered for the Spaulding Turnpike. The 2-lane scenario represents 2 lanes in each direction northbound and southbound, likewise for the 3- and 4-lane scenarios. A negative number represents vehicles removed or peak shifted from the road segment. A positive number represents vehicles added to the roadway segment. In addition to the Spaulding Turnpike, peak shifting volumes are

provided for the three alternative north-south routes available within the region – Maine Route 236, NH Route 108, and NH Route 125.

Table 1:Peak Shifting Results for 2025

AM Peak Shifting	ME 236		Little Bay Bridges		NH 108		NH 125	
(Vehicles)	SB	NB	SB	NB	SB	NB	SB	NB
2-lane	-30	0	-170	0	-45	0	-40	0
Alt 3-12 3-lane	0	0	-5	0	-5	0	-5	0
Alt 3-12 4-lane	0	0	0	0	0	0	0	0

PM Peak Shifting	ME 236		Little Bay Bridges		NH 108		NH 125	
(Vehicles)	SB	NB	SB	NB	SB	NB	SB	NB
2-lane	0	-30	10	-160	-5	-45	-10	-45
Alt 3-12 3-lane	0	-25	10	-145	-5	-20	-10	-20
Alt 3-12 4-lane	5	-15	10	-115	-5	-15	-10	-15

The table shows that congestion on all the studied roads is higher southbound in the AM and northbound in the PM. In both the AM and the PM, congestion appears to be worst on the Little Bay Bridges as shown by the high number of vehicles spread to a shoulder peak hours. The results indicate that motorists are more likely to peak shift under the 2 lane No Build condition than under the 3 and 4 lane Build scenarios for the Spaulding Turnpike. However, the number of motorists observed peak shifting between the No Build and Build scenarios is not substantially different. It is important to point out that this is not a result of the Spaulding Turnpike having adequate capacity to accommodate the additional volume under the Build scenarios. This is in part a result of other roadways in the region (that connect to the Turnpike) that will continue to operate at or near capacity in the future. For example, in the future year 2025, US Route 4 is anticipated to experience congestion during the peak hours. Therefore even under the 4 lane Build condition, it is likely that some motorists will continue to shift to the shoulder peak hours to avoid congestion on US Route 4 regardless of the fact that there will be no delay on the Turnpike.

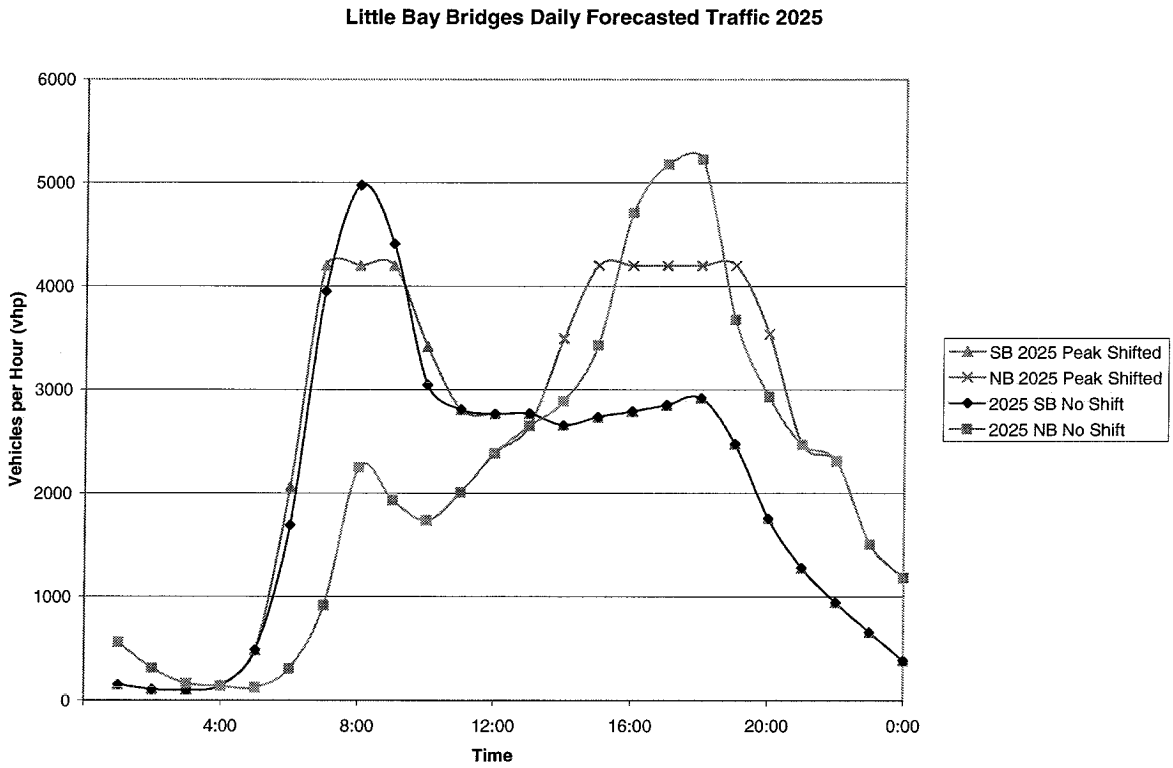
PEAK SPREADING

Peak spreading occurs when the hourly volume demand on a roadway exceeds the capacity of the roadway to process it. Under this condition, the peak travel demand on the Turnpike actually exceeds a one hour period resulting in more hours of congestion during the day.

The peak shifting methodology (above) allows demand to exceed capacity so that it is possible to have vehicle volumes on roadways that are over the roadway's capacity. This occurs in the 2-lane scenario for both the AM and PM peak hours in their respective peak directions. To estimate an actual vehicle volume on the roadway, we used a post-model methodology to estimate peak

spreading, i.e. the number of vehicles that cannot be serviced during the peak hour and are therefore shifted to the shoulder hours. The model used to estimate this phenomenon is very similar to the old peak spreading methodology. Assuming that distribution of trips as shown in Figure 1 on the Little Bay Bridges does not change between 2000 and 2025, we can estimate the daily distribution of trips on the bridges for the 2-lane scenario. Figure 2 demonstrates the level of congestion expected under the 2-lane scenario.

Figure 2: 2025 Daily Traffic Volumes on the Little Bay Bridges



As shown in Figure 2, by the year 2025, congestion on the Turnpike will spread to more than one or two hours during the weekday morning and evening commuter times. Based on model projections, the Turnpike could operate at or near capacity for 2 to 3 hours in the southbound direction in the morning and 4 to 5 hours in the northbound direction in the late afternoon/evening.

ROUTE DIVERSION

Route diversion occurs when a motorist chooses to travel on a different route that is less congested. This may occur when a route with a longer distance yields a similar travel time to a previously used route. In this particular case, alternative north-south routes to the Spaulding Turnpike include Maine Route 236, NH Route 108, and NH Route 125.

Resource Systems Group was asked to use the model to assess route diversion from Spaulding Turnpike to the remaining three critical north-south routes discussed above. Route diversion can be assessed through variations in the travel time between 2000 and 2025 on the routes for each scenario. Travel time is directly related to the volume of traffic; as traffic increases, the travel time increases.

The model travel times between two points in the model were generated for each route for the years 2000 and 2025. For NH 125 and NH 108, the travel time was generated between NH 101 and US 4. For Spaulding Turnpike the travel time was generated between the I-95 merge in the south and the Dover Toll Plaza in the north. For ME 236, the travel time was generated between I-95 and the intersection of Old Dover Road and the border between New Hampshire and Maine. Table 2 shows the change in travel time between 2000 and 2025 under the No Build and Build scenarios. A negative time signifies a decrease in travel time (expressed in minutes). A positive signifies an increase in travel time.

Table 2: Change in Travel Time Between 2000 and 2025

AM Change in Travel Time from 2000 to 2025 (Minutes)

	Route 236 Maine		Bridges		Route 108		Route 125	
	SB	NB	SB	NB	SB	NB	SB	NB
2-Lane	9.4	-0.3	7.5	0.7	5.9	1.3	4.1	1.6
3-Lane Alternatives 3 & 12	5.2	0.0	0.2	0.4	3.8	1.7	3.3	1.6
4-Lane Alternatives 3 & 12	2.9	-0.4	-2.6	0.3	2.5	1.6	1.8	1.6

PM Change in Travel Time from 2000 to 2025 (Minutes)

	Route 236 Maine		Bridges		Route 108		Route 125	
	SB	NB	SB	NB	SB	NB	SB	NB
2-Lane	4.1	11.9	3.5	10.7	6.1	6.4	5.9	5.8
3-Lane Alternatives 3 & 12	1.9	1.3	0.0	-3.1	5.5	1.1	5.2	2.1
4-Lane Alternatives 3 & 12	1.9	-0.4	-0.9	-6.2	5.5	0.8	5.0	1.9

As shown in the above table and the peak spreading table, the 2-lane bridge scenario is the most congested scenario network-wide. Travel times in the peak direction increase significantly between 2000 and 2025 for all roadways. However, under the Build scenarios where more lanes are added to the Turnpike, travel times during the peak hours not only decrease (and improve) for the Turnpike, but travels times also decrease for the alternative routes. Decreased travel times on Maine Route 236, NH Route 108, and NH Route 125 are a result of vehicles now using the Turnpike instead of

these alternative routes. This is important to note whereas it marks the regional significance of the Spaulding Turnpike project beyond the immediate study area documented in the Scoping Report and Rationale Report.

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